## NEXT MONTH

**To make America strong and safe from any foreign attack on its institutions, is our No. 1 job. For those of us in chemical industry it means a rapid expansion of production facilities plus conservation of manpower and equipment to get maximum output in minimum time. Plant safety therefore becomes an even more vital consideration.**

**Next month The National Safety Congress and Exposition in Chicago will have a lot to say about the relations between National Safety and National Defense. Next month *Chem. & Met.* will devote its special editorial report to the status of accident prevention and safe practices in American chemical industry. Timely topics for all of us to be thinking about!**


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# CHEMICAL & METALLURGICAL ENGINEERING


ESTABLISHED 1902


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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

SEPTEMBER, 1940

S. D. KIRKPATRICK, *Editor*

# FROM AN EDITORIAL VIEWPOINT

## NINTH IN THE SERIES

WHEN WE PUBLISHED our first "Corrosion" issue back in 1923, it was with the promise that the problems of materials would be reviewed as often as progress warranted. Cast iron, lead and wood were then the principal materials for chemical construction. Stainless steel and the newer alloys—of which someone has estimated that there are now 10,000—were just coming into use. Progress at first was slow and faltering, and the intervals between our issues were correspondingly long. Now the whole field is moving at an ever accelerated pace, and our task increases in proportion.

This ninth in our series has required herculean effort to compile and condense within usable, practical form, the chemical and physical data and trade information which the chemical engineer needs to know about corrosion-, heat- and abrasion-resistant materials. We have been persuaded to return to the practice last used in 1929 in order to bring all of this information into a single tabulation, more convenient for comparison, and more readily filed or mounted on the bulletin board in the engineering department. But this year's chart is equivalent to 32 pages and it deals only with the metals and alloys! Corresponding data for nonmetallics will be found in pages 605–12. The whole report is presented for your careful study and practical use. We hope it serves you well.

## PENALIZING PRIVATE ENTERPRISE

COMMERCIAL TESTING LABORATORIES have been told that they have no place in the government's procurement program. Years ago the Comptroller-General ruled against a naval officer who had employed a commercial inspection agency on the ground that no expenditure of funds for such purpose had been specifically authorized by legislation. As a result of this precedent the military arms of the government have been forced to rely on the services of government employees even though they might prefer the more experienced and competent advice of the independent agencies that so often referee similar transactions in industry.

Impediments in the way of the commercial testing laboratories should be removed promptly. These organizations of private enterprise should be given their opportunity to serve the country and to use their specialized facilities to the best advantage for the National Defense.

## "BANKABLE" CONTRACTS FOR DEFENSE PLANTS

CONTRACTS FOR THE CONSTRUCTION of government plants for smokeless powder and high explosives were among the first to be signed because they involve none of the amortization and tax problems that have been plaguing other industries. It was simply a case of the government needing for the national defense certain material for which there was no peace-time counterpart. These plants are, in effect, government arsenals, government-owned but built and operated by experienced private industries.

A different situation exists in the case of plants making certain types of aircraft, engines, or other munitions which might later have commercial use. If the manufacturer of such material does not have the money for the necessary plant expansion and cannot get it from his private banker or from R.F.C., he has so far been stymied in his efforts to secure a government contract. Now comes the proposal from the National Defense Advisory Commission of a unique plant-option plan of financing. Here the government and the manufacturer get together on the contract for a certain quantity of material to be delivered over a five-year period and at a certain unit price based on direct production costs. The government further agrees to pay for the entire cost of building the new plant in five annual installments. At the end of the five years the government owns the plant, of course, but the plan

provides that industry has the right to buy it back at a fair price or surrender it to the government, for sale elsewhere, for maintenance in standby condition, or for demolition and salvage.

There seem to be many advantages in this plan provided a number of practical details (including taxes) can be satisfactorily worked out. From the government's standpoint it would help to build up armament facilities that need not be destroyed immediately after the emergency passes, as was the case following the last war. From the standpoint of industry it would provide a favorable basis on which money could be obtained from private sources, thus freeing government credit for more productive uses. Neither the manufacturer nor the government would assume in advance all the risks, nor subsequently reap as a profit the residual value.

The only serious question — and the one that deters certain industries from giving wholehearted support to this plan for "bankable" contracts — is the fear of government ownership. A lot depends on how much of a chance one is willing to take on the policies of those who will be in control of the government five years hence. Those companies that can afford it will probably prefer to risk their own money rather than to invite governmental competition in the future.

## GOSSIPING ABOUT "BOTTLENECKS"

CERTAIN WASHINGTON newspaper columnists have long capitalized on their allegedly intimate knowledge of what is going on in the innermost workings of our national government. Some boast privately of secret pipelines into departmental and other high executive offices. In their gossipy fashion they like to produce startling stories weeks or months in advance of official utterances. As with most other gossips, mere facts are often allowed to become submerged by far fetched "deductions" and frequently some innocent party is damaged.

On July 25 the newspapers that feature "The Washington Merry-Go-Round" carried a story by Drew Pearson and Robert S. Allen purporting to show that "Andrew Mellon's Aluminum Corporation of America was one of the U. S. concerns cooperating with Germany to maintain high prices on certain raw materials necessary for the national defense." It was stated that this corporation controlled our supply of magnesium metal and through a patent holding company owned jointly with the I. G. Farbenindustrie of Germany "had enjoyed virtually a world monopoly of this metal."

The facts of the case, as most *Chem. & Met.* readers well know, are that the Dow Chemical Co. has long been the sole producer of magnesium metal in this country. Its pioneering development has been a great and typical achievement of American research. Production has mounted far in advance of demand while prices have been steadily reduced. Production facilities were doubled in February and will be redoubled by the completion of the new sea-water plant in Texas before the end of this year. Dow owns its own production patents and by agreement with others, licenses without fee, all firms who fabricate its metal. The American Magnesium Corporation, which is one of these, has not produced a pound of virgin magnesium since 1927.

Not content with this attempt to imply unpatriotic and ulterior motives on part of the Aluminum company, our gossiping columnists ironically point out that "The other day John W. Davis, attorney for the Aluminum Corporation of America, came in to see the Assistant Attorney General Thurman Arnold, who has done more to reduce prices than any other man in America, and promised him the full cooperation of his client. He said the Aluminum Corporation would be glad to produce magnesium for national defense purposes and cooperate in every other way possible."

The fact, as Mr. Pearson has subsequently admitted, is that it was Mr. Arthur V. Davis, chairman of the Aluminum company, rather than the distinguished New York lawyer, who called at the Department of Justice and it is just possible that the business he had with the Department of Justice was in connection with the government's two-year-old suit against his company, about which so much political capital has been made in recent months.

All this might readily be dismissed either as just another leak in the pipeline or as a gossipy garbling of facts to make a good story. But it was only the prelude to the real denouement.

On August 8, Mr. Arnold himself came to New York to meet the newspaper reporters and tell them the real story of the "bottlenecks" he had discovered in ten production fields that were vital to the national defense. Magnesium was high on his list and again the Nazis' patent control was blamed for low output and high prices. These alleged facts were said to have been obtained as a result of a grand jury inquiry that had been under way in Washington since July 11 — two weeks in advance of the Pearson-Allen story. An interesting but, of course, entirely incidental feature of the Arnold interview, as reported in the *New York Times* of August 9, is that the word "bottleneck" appeared in the front-page headline and several times elsewhere in the story. On the following day Mr. Arnold's publishers announced the publication of another timely volume by the well-known author of "The Folklore of Capitalism." Its title is "The Bottlenecks of Business."

But isn't it about time that political self-seekers, in their bid for cheap publicity, and gossiping columnists make someone other than American industry the goat for their destructive gossip? Whether headline hunter or office holder, it strikes us that it comes exceedingly close to sabotage when facts are dealt with so carelessly as to create an implication that American manufacturers are conspiring with Germany to defeat our present national defense program.

SERIES A, NUMBER SIX

CHEM & MET REPORT ON

# CORROSION, HEAT, ABRASION-RESISTANT MATERIALS FOR THE CONSTRUCTION OF CHEMICAL ENGINEERING EQUIPMENT

*to plant managers, superintendents, chemical engineers*

Introduction of the use of stainless steels in the chemical process industries, following shortly after World War I, marked the beginning of a new era in the field of materials of construction. Prior to that time corrosion had been accepted as an evil about which nothing much could be done. Not only did their development make available a new group of materials that experience has shown to be of tremendous importance from the standpoint of corrosion resistance, but their influence in other directions has been far reaching. Their success naturally led to modifications of plain cast irons and steels in the form of additions of small amounts of alloying metals and to the formulation of numerous highly alloyed steels. Meanwhile, the activity among metallic materials had its influence upon such long established non-metallics as chemical stoneware, glass-lined steel, and rubber, leading to products offering vastly improved physical and chemical characteristics.

This same period has witnessed the development of other new types of construction materials, impervious carbon and graphite, synthetic resins, and rubber-like products. It has seen the perfection of methods of applying a thin layer of stainless steel, nickel or its alloys, silver or the noble metals, onto a base of plain steel.

The interest in materials of construction has spread among chemists and engineers everywhere, resulting in an enormous number of investigations into the causes and prevention of corrosion. In fact, there have been so many independent corrosion studies that an effort recently has been made to avoid duplication of endeavor by organization of the American Coordinating Committee on Corrosion.

These new materials of construction with their increased resistance and the knowledge of corrosion that is being accumulated from the many investigations are providing the chemical engineer and equipment designer with new facilities for meeting the increasingly severe demands of the process industries. While there is still much to be known about all phases of the problem, greater progress has been made during this era than ever before.

CHEMICAL & METALLURGICAL ENGINEERING

TITLE OF REPORT Materials of Construction

TO Chemical Engineers and Equipment Designers

FROM Chem. & Met. Editors

DATE September 1940

INTERPRETATION › **This report serves to bring chemical engineers up to date on the progress that has been made in recent years in the field of construction materials. The significant new developments and trends are summarized in the article commencing on this page. Properties of the ferrous and non-ferrous alloys are presented on the accompanying large wall chart. For each material is given the manufacturer's name and address, physical and mechanical properties, and resistance to corrosion of several of the most commonly encountered chemicals. Comparative prices of stainless steels, an important factor in the selection of a material, are included in this report for reference purposes. Non-metallic materials are grouped according to type; each is accompanied by such important information as manufacturer's name and address, physical and mechanical properties, and in some cases by corrosion resistance data.**

# New Developments and Trends

**JAMES A. LEE,** *Managing Editor*
*Chemical & Metallurgical Engineering*

PREPARATIONS for national defense are going to subject materials for the construction of chemical engineering equipment to the most severe test they have ever been called upon to meet. As this is being written government officials and their industrial advisors are working at a feverish pitch making plans and signing contracts. The big "push" is in its formative stage. Shortly the results of this great drive will begin to appear in the form of increasing industrial activity; new manufacturing plants will be built, existing ones will be forced to the limit of their endurance to produce more and more, pressures will be increased, temperatures raised, shut-downs for cleaning, inspection and repair will be reduced, "capacities" will be exceeded. Plant and equipment will be operated far beyond what was thought practical or even possible in normal times.

Can the materials of which the equipment is constructed stand the strain? One thing is certain, this severe service is going to require the best that is available. There will be no time for frequent replacement of the more readily corroded materials. Materials that were once considered economical to use because of their comparatively low initial cost will no longer be tolerated. Shut-downs for replacement will be too costly. The best available will be the most economical and will be demanded.

Far greater pressure on productive activity will be experienced during the next few years than was ever reached during the last World War. Everything will be done on a greater scale. Materials of construction that were adequate in 1917 and 1918 would not be able to stand the demands of 1940 service conditions, but unbelievable progress has been made in the 22 years. The whole field of materials of construction has passed through a transition, the significance of which most engineers have failed to appreciate. Not only have such long established materials as cast iron and steel been subjected to changes by the addition of other elements, but the renowned stainless steels were almost unheard of during the last crisis.

Even a few years ago, the most visionary chemical engineer could not have foreseen that such materials as carbon, glass, silver and synthetic resins would be used so extensively for the construction of large-scale equipment. The synthetic rubber and rubber-like materials were still laboratory curiosities. And great progress has been made in improving the characteristics of chemi-

cal stoneware, glass linings, cements, refractories, natural rubber, and other long established materials.

Volumes might be written about the evolution through which materials for the construction of chemical engineering equipment has been passing but it would be dull reading and of little practical value. The chemical engineer is more interested in the materials that are at present available and so we will confine our attention to a discussion of the present trends and new developments in the field of materials.

Cast iron has long been a standard material but the cast iron of today is not the cast iron of five or even three years ago, for the metallurgist has given it new and important characteristics by alloying it with nickel, chromium, molybdenum, copper and other metals. As a result of this modification several of the irons are satisfactory for use in corrosive media and at higher temperatures than heretofore. A small amount of chromium and nickel stabilize the structure of cast iron and then increase its toughness, strength and abrasion resistance. Larger amounts of these alloying materials render the iron truly resistant to attack of many chemicals.

### TRENDS AMONG 18-8 ALLOYS

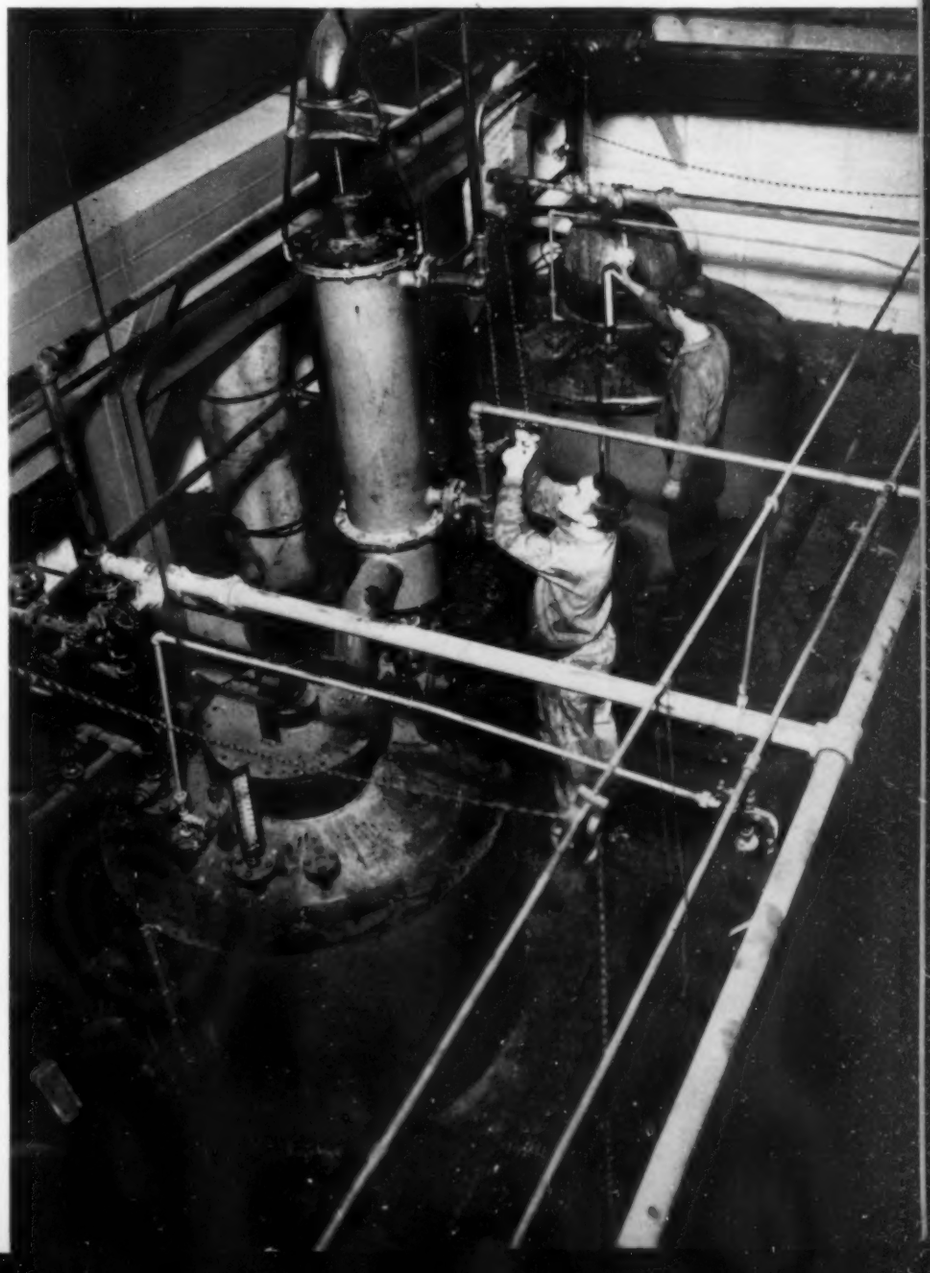
Ever since the 18 per cent chromium-8 per cent nickel alloy containing molybdenum first became available it has been in demand due to the added corrosion resistance conferred by the molybdenum. During the past two years the demand for this material has greatly increased. Since this alloy is susceptible to intergranular corrosion when exposed to a certain temperature range, industry has demanded that it be made immune to intergranular corrosion. This requirement has been met in the straight 18–8 alloys, as is well known, by the addition of columbium or titanium. However, it was only recently that additions of columbium were successfully made to the molybdenum bearing chromium-nickel alloys. These columbium bearing alloys are now available where the chrome-nickel-molybdenum types are necessary and must be free of any susceptibility to intergranular corrosion.

The uses of austenitic chromium-nickel steels which are cold worked to greatly increase their tensile properties for high strength, light weight applications are broadening rapidly. A low-temperature heat treatment below 600 deg. F. (normally practiced between 350-600 deg. F.) has been found materially to improve the elastic properties of the steel.

There is a trend toward raising the manganese in all types of austenitic steels to improve the hot ductility which is important in welding operations. Most of the specifications covering austenitic steels have been rewritten recently to allow 2½ per cent (maximum) manganese. This compares with an old maximum of 0.7 per cent. The increased amount of manganese has no detrimental effect on corrosion resistance, in fact it slightly improves the corrosion resistance with no significant change in physicial properties.

The petroleum refining industry requires alloy castings of the 24 per cent chromium-12 per cent nickel type for high temperature applications such as tube supports. The specifications for this material are unusually severe since they demand a material which has a high creep strength at temperatures as high as 1,800 deg. F. and good ductility after operating within a temperature range which normally tends to drastically reduce ductility. The industry has been aided in meeting these requirements by the addition of manganese in amounts of between 4 and 4½ per cent. It has also been shown that these conditions can be more easily met if part of the carbon is replaced by an equivalent amount of nitrogen.

Early reports that columbium improved the creep strength of the 4 to 6 per cent chromium steels have now been confirmed. This is of enormous importance to the petroleum refineries for they are large users of this



**Operating under partial vacuum, these direct-fired, welded Inconel kettles process a high grade of linseed oil**

metal in the form of tubes and at high temperatures.

A development of more than passing interest is the approval and setting up of specifications covering certain grades of stainless steels for the construction of unfired pressure vessels by the boiler code committee of the A.S.M.E. The steels specified are types (Iron and Steel Institute numbers) 304, 316, 317, 321, 347. Their chemical composition may be found on page 603-604.

In recent months stainless-clad steel made by a new method was made general available. The Puramelt process of the Allegheny Ludlum Steel Corp. produces single ingots of two or more compositions, integrally bonded together. These clad materials may be used to advantage for certain types of relatively heavy-wall equipment where solid stainless steel is not necessary or the cost would be prohibitive. Also for many applications where the slight contamination obtained from ordinary carbon steel is objectionable. Any of the corrosion-resistant steels are available on a plain steel base.

Developed originally for the fabrication of thin stainless steel for railroad cars and airplanes, the "Shotweld" process has recently been applied to the production of lightweight, high-strength stainless steel processing equipment. Because of the short time during which the weld area is in the dangerous temperature range, "shot" welded equipment ordinarily does not require subsequent heat treatment to maintain a satisfactory corrosion resistance. Applications include centrifugal baskets, materials handling containers, ducts, fume hoods, lids, kettles, tanks in wide variety, and rayon machinery.

## NON-FERROUS METALS AND ALLOYS

The nickel alloys have been keeping up with the progress being made among materials in general. Inconel, Z nickel and K Monel have come into production in a greater variety of shapes. K Monel, a high-strength heat treatable alloy, is now available in the form of seamless tubing. It is useful in such applications as pump shafts, and valve disks and stems for high-temperature steam lines. Another use recently developed is for corrosion-resisting ball, roller and other types of bearings exposed to corrosive attack.

Z nickel is said to combine the corrosion resistance of nickel with the mechanical properties of heat-treated steel, having a strength from 2½ to 4 times that of ordinary structural carbon steel when heat treated.

Illium and Hastelloy C can now be obtained in a variety of rolled forms. And Hastelloy B is available in commercial quantities. Monel has been added to the list of materials available in clad form. Monel-clad steel is being used for drying equipment in salt refineries and for other purposes.

Methods for the attachment of sheet metal to steel surfaces either prior to or following fabrication of equipment are now being applied to the high nickel alloys. Considerable quantities are being used in petroleum refineries. The application of corrosion resistant sheet metal coverings on rolls, originally developed for paper machines, has been extended to covers of rolls for the chemical industry, such as flaker and dryer rolls.

The 70 per cent copper—30 per cent nickel (cupro nickel) condenser tubes used so extensively in marine service are now being applied in the chemical industry to take care of abnormally severe conditions on either the cooling medium or vapor side.

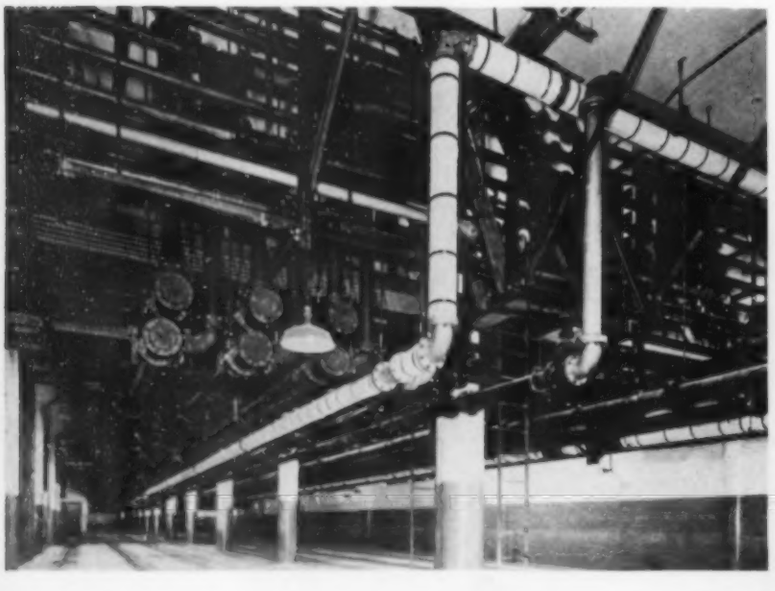
There has been a useful addition to the Ni-Resist family in the form of 30 per cent nickel iron which because of its relatively low expansion is used in process industry equipment which is subjected to thermal shock associated with rapid changes of temperature.

Nickel castings are being made which have improved gall resisting characteristics. They are being used in pumps and other equpiment where it is necessary for moving parts to run in close contact, for example stuffing boxes in autoclaves. There is also increasing use of S Monel castings where resistance to galling is important.

The American Silver Producers' Research Project has concentrated on the development of a pore-free silver plate shipping container. It is said that deposits of 0.001 in. thick on deep drawing steel are readily obtainable.

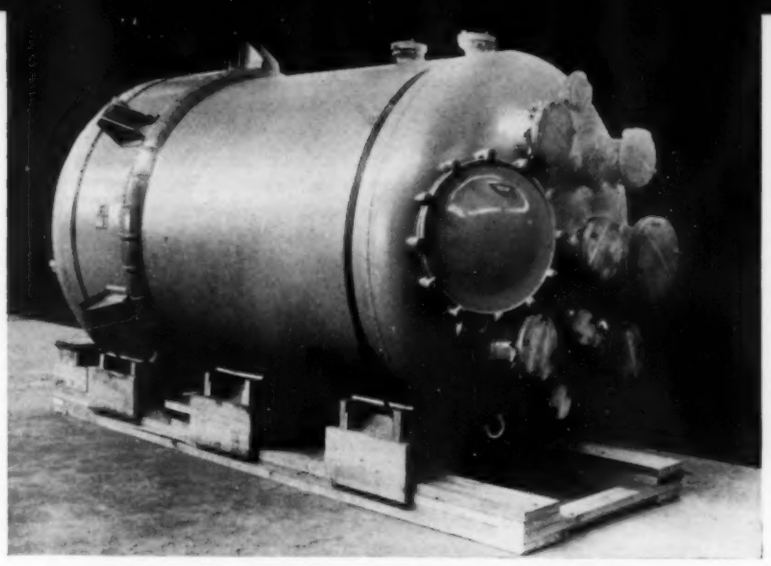
New possibilities in the use of light-weight materials for many purposes have been opened by recently developed methods for the plating of aluminum sheets with nickel and with nickel and chromium. This development makes it possible to utilize the mechanical properties and light weight of aluminum and widens the range of corrosive conditions where aluminum can be used in the chemical industries.

Another development that is just now completed is the hot dipping of steel sheets in molten aluminum to give a coated sheet. It should offer the strength of the base steel with the corrosion resistance of the aluminum.



**Over 12 miles of hard rubber pipe and fittings in a rayon plant**

**Acid-proof brick (laid in acid-proof cement) tank for chromium plating**



**A 2,000-gal. glass-lined steel tank for high-pressure operation. Note large number of openings in the top head once thought impossible**

When long life in hard service and absolute purity of product are required, noble-metal clad material is now available in a variety of forms (rod, wire, seamless tubing, sheet, etc.) and chemical equipment is now being fabricated from these forms.

Seamless composite tubing up to 1¼ in. pipe size and sheet up to 4 ft. x 8 ft. are available; the noble metal layer may be any thickness down to 0.002 in. For larger pipes and vessels liners of noble metal are inserted; the liners may be attached by soldering or welding, or may simply be inserted as a separate liner. The coatings may be platinum, iridio-platinum, palladium, gold, gold-platinum alloys, etc., and the base metals may be copper, brass, nickel and nickel alloys, steel, etc. The original cost of such noble clad materials is naturally somewhat higher than base metal but the high, readily-realizable scrap value makes them a real commercial proposition.

Up to the present time much of this clad material is finding use in heat exchangers and similar equipment; also for valves, frangible disks, thermometer wells, electrodes, autoclaves. Where special purity is needed in certain fine chemicals and pharmaceuticals platinum clad vessels have been found essential.

### CHEMICAL STONEWARE AND PORCELAIN

The steady improvement in the long-established equipment materials, while less spectacular, is no less important to the chemical industries. Stoneware has many points in its favor in comparison with other equipment materials and it is almost invariably much less expensive. The common practice in such cases is to use stoneware up to the limit of size that is available. It seems probable that 1,600 gallons is close to the practicable limit of size for stoneware vessels as manufacturing difficulties increase enormously with increased dimensions. However, in regular production the limit is probably between 800 and 1,000 gallons depending on the shape and the purpose for which it is to be used.

The advantage of stoneware as an equipment material may often be extended to larger units by using it in the form of a protective lining for shapes built of concrete, brick, metal or other base.

In recent years much greater accuracy is possible in making stoneware equipment. The manufacturer is able not only to maintain dimensions within a tolerance of ± 2 per cent but by far the greater part of his products is kept within much closer limits. This uniformity makes possible the fabrication of extremely complicated shapes that were heretofore impracticable and also the grinding and polishing of the finished ware to a precision comparable with that obtainable with metals.

The most noteworthy achievement in the field of chemical stoneware has been the development of new ceramic bodies to meet the increasingly severe operating conditions that the chemical engineering progress has demanded. Ware made from cordierite has a thermal expansion much below that of the average grade of chemical stoneware and consequently will withstand thermal abuse that would be impossible with the regular product. This ware has the further advantage that the absorption is practically nil, it is much stronger than the regular product and has excellent resistance to caustic solutions.

Stoneware containing a large amount of silicon carbide is now available with much higher thermal conductivity, and with an absorption comparable with that of the regular grade of stoneware. It can be glazed either the conventional brown color or white and a method has been developed for grinding it. This new ware is about four times as strong as former products and will withstand almost any kind of thermal abuse between atmospheric temperature and about 400 deg. C.

A development of the last two years is a line of chemical porcelain ware which is now available in numerous types and sizes of plant equipment such as pipe, fittings, valves, jars, kettles, pots, filters and tower packings. Described as a true hard porcelain, the body employed is of extremely high mechanical strength and zero absorption. Being unaffected by all acids except hydrofluoric, and resistant to alkalis, the new ware is being advanced by the manufacturer for a wide variety of severe applications.

### GLASS AND GLASS-LININGS

In the process industries glass was once limited to use in the laboratory, but within recent years although it may not be fully realized, glass has become employed to a very considerable extent as a chemical engineering material. This is in part due to the improved technique of manufacture which makes possible shapes and weights of single pieces previously considered impossible.

It is only in recent years that stills, absorbers and columns, valves, pumps, industrial piping and fittings, heat exchangers, filter blankets and a variety of other equipment made of glass have been available for plant service. Glass is perhaps most widely used in the form of piping which is available in 1, 1½, 2, 3, and 4 in. inside diameters, and in lengths of up to 10 ft. Joints are easily assembled and of rugged construction. The assembled piping is suitable for 100 lb. per sq. in. maximum working pressure in the sizes up to 3 in. and 75 lb. per sq. in. for the 4 in. size.

An entirely new method of glass manufacture yielding products which can be heated to cherry red and then plunged into ice water without breaking was announced a year ago. Since then considerable progress has been made with this new ultra-low expansion glass, Vycor, and a limited supply of laboratory ware is now available. The outstanding significance of this glass is that it offers in an economical price range a material similar to fuzed quartz. Its thermal expansion per degree centigrade is $0.080 \times 10^{-6}$ and the soften-

ing temperature is about 2,750 deg. F.

Another recent development is glass fiber for use in filtering liquids and gases or as thermal insulation. Density of packing determines heat transmission.

Glass-lined steel equipment for use in the chemical process industries has made definite progress in development during the past year, particularly as regards a substantial increase in the maximum unit size offered for servere acid conditions. Units of 2,000 gallon capacity are now available as standard equipment and even larger units have been fabricated according to special design.

This increase in size has been accomplished by a broadened range of related working pressures, as permitted by improved technique in fabricating and enameling where greater thickness of steel is concerned.

Yet another comparatively recent improvement is the adoption by at least one manufacturer of a far more drastic test specification than ever before, namely that glass enamel for severe acid service must pass a 20,000 volt electric test. As a result flaws of even microscopic proportions can be discerned and corrected. This results in a greater service life of equipment.

### STRUCTURAL CARBON AND GRAPHITE

The use of structural carbon and graphite in recent years has sharply increased for a wide variety of process industry applications. Brick, blocks, tile and special shapes of carbon and graphite are being used for complete towers, for lining of towers, vats, tanks and digesters, for atmospheric condensers and electrostatic precipitators. Tubes and pipes find their applications in the handling of corrosive fluids and in the construction of heat exchangers ranging from simple to complex.

Many carbon and graphite articles are made impervious by special treatments, which change their characteristics to some extent. The product known as Karbate has its porosity reduced to practically zero and permeability eliminated. Its strength is about double that of the base material. To date Karbates are not available in all sizes in which the base materials are made. However, to give some idea of available sizes, tower sections up to 24 in. O. D. can be produced. Large plates, tanks, etc., have been produced by cementing slabs together. Individual slabs run to 6 ft. in length. The widest application of Karbates is in pipe form. A complete line of pipe and fittings from ½ in. I. D. to 6 in. I. D. is available. Threaded or flanged connections are regularly used. With a small amount of practice, a maintenance crew can cut, thread, and fit lines without undue breakage or difficulty.

### RUBBER AND SYNTHETIC RUBBER

Since the last World War hard and soft rubber linings for industrial applications have been developed to a point where they are being advantageously applied to many types of process, storage and conveying systems. Rubber compounds capable of meeting more severe conditions of service have been made available to industry. And hard rubber equipment has found an ever increasing demand from chemical engineers in the process industries.

The national emergency is focusing the attention of the entire country on the importance of the synthetic rubber-like products. Pyroflex, neoprene, Koroseal, Pliolite, Resistoflex Buna Ameripol and other such materials are all newcomers. To the chemical engineer these interesting products not only offer substitutes in the event that the United States is cut off from the sources of supply of natural rubber, but also make available materials with certain characteristics not possessed by any other products.

For the most part the synthetic rubbers are useful in the chemical industries where the physical properties of rubber are desirable along with resistance to solvents, hydrocarbons and other chemicals that attack natural rubber. They are being used alone or compounded with rubber. At present they find their widest application in the form of molded articles, hose, hose linings and fabric coatings. Several of these new materials are being used for lining tanks.

While the phenolic resins were developed in 1907 it was not until a few years ago that they were employed for the construction of equipment. Today they are used in the heavy chemical, pulp and paper and other process industry plants. If the story could be told of how extensively this type of material is being used it would surprise many engineers.

The molded resins are resistant to solvents, acids, alkalis, and are tough, hard, and durable. The laminated resins serve many purposes. They resist the attack of most chemicals—acids, solvents and oils. They are unaffected by most organic acids and dilute mineral acids.

Phenolic resinous equipment, Haveg, is supplied in one piece molded construction in single units ranging in size from a quart dipper to a 5,000 gallon tank. The finished vessels have a compact, impervious, homogeneous structure with smooth jointless surfaces. Large equipment is provided by assembling flanged units to provide practically any size or shape of tank required. Other applications include: pipe, valves, absorbing and scrubbing towers, agitators and stirrers, crystallizing dishes, drying trays, evaporating and concentrating equipment, fume duct, and fan housings, rolls, reels and textile dyeing equipment.

Several of the other new plastics are finding uses in the process industries. For example, cellulose nitrate is being used to shield underground pipe lines against soil corrosion. A three-year test on a long line, in a soil known to be highly corrosive, proved very successful. Lucite is used in the fabrication of pumps and is said to be satisfactory for handling some chemicals.

Now that the vinyl resin fiber filter cloth has passed the experimental stage, its application to numerous types of filtration is growing. Because of its acid and alkali resistance the use of Vinyon filter cloth in processes involving strong acid or alkali solutions eliminates the expense of frequent replacements and the cost of idle equipment while changing filter blankets. The synthetic resin filter fabrics are now being used in connection with dyestuffs, bleaches, pigments, pharmaceuticals, concentrated caustics, phosphoric acid and other chemicals that are often handled.

Synthetic resins are being used as protective coatings. The new anticorrosive paints are based, besides general durability, on moisture and alkali resistance and the presence of inhibitors in the pigment.

### A MASS ATTACK ON CORROSION

Supplementing the efforts of the metal, stoneware, glass, rubber and other materials of construction producers to develop new materials with improved mechanical properties and greater corrosion resistance is an investigation of the subject of corrosion by numerous technical societies, government bureaus, research laboratories of material producers and other organizations. These bodies are making a mass attack on the fundamental and practical aspects of the causes and prevention of corrosion.

So numerous have these efforts become that two years ago the American Coordinating Committee on Corrosion was formed to coordinate research activities in this extremely interesting field. It is patterned after similar organizations in England, Holland, Belgium and other countries abroad, and is sponsored by and composed of delegates of 20 or more organizations interested in corrosion. The purposes of the Committee are: (1) To serve as a clearing house and coordinating agency for information on experience and work in progress in this country in the field of corrosion and corrosion prevention; (2) To compile a list of the names and addresses of all individuals in America working in the field of corrosion, together with information as to their special interest (This directory has now been completed); (3) To serve as an agency for the exchange of corrosion information and experience with similar foreign agencies such as the Corrosion Committee of the British Iron and Steel Institute, and (4) to serve as a medium through which individual workers may make contact with other investigators here and abroad in specific fields of corrosion work.

The sponsoring organizations are:
American Chemical Society
American Electroplaters Society
American Foundrymen's Association
American Gas Association
American Institute of Chemical Engineers
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Society of Heating and Ventilating Engineers
American Society of Mechanical Engineers
American Society of Refrigeration Engineers
American Society of Metals
American Society for Testing Materials
American Water Works Association
Battelle Memorial Institute
Electrochemical Society
Mellon Institute of Industrial Research
National Bureau of Standards
National District Heating Association
Society of Automotive Engineers
Technical Association of the Pulp and Paper Industry

In addition to these agencies that are actively engaged in corrosion investigations, many producers of materials of construction have extensive research laboratories which are engaged in corrosion studies in an effort to improve the resistance of the companies' products and to determine their suitability for various corrosive mediums.

Many of the plants of the process industries are constantly engaged in research and development of their own. The larger companies have staffs who devote their entire time to the consideration of the corrosion of equipment and to the application of the recently introduced materials that are offered to prevent attack from acids and other chemicals.

# METALS AND ALLOYS

Of all available materials of construction, the group composed of metals and alloys is by far the most extensively used. Many of the physical and chemical data and much trade information which chemical engineers need to know about those corrosion, heat and abrasion resisting materials have been condensed for the large wall which has been folded and inserted under the front cover of this issue of *Chem & Met.*

### PRICES OF STAINLESS STEELS

One of the determining factors in the selection of a material from which to construct equipment for use in the chemical industries is price. When several materials are of equal suitability from all other considerations the engineer naturally chooses the one that is obtainable at the lowest cost. For the purpose of assisting in the selection, the current prices of some of the stainless steels in wrought form are given in the accompanying table. While these prices may change slightly from time to time it is probable that their relation, one to another, will continue as at present. It is essential to keep in mind that these are base prices of the steels in the form of plates, sheets, cold rolled, strip, and so forth. And while the prices are comparable and therefore offer a useful guide, when selecting materials of construction other factors enter into the delivered cost of the alloy steel sheet, bar, wire, or other form. To the base price of the steel must be added extra charges that are due to such factors as quantity of the material ordered, the degree of surface finished specified and whether one or both sides are polished, width, length and thickness. It is sometimes necessary to specify other requirements that add to the cost. Among those that should be mentioned are: close tolerance, testing, packing, machining, perforation, cutting to size, and in the case of bars, shape. While this list of extras may appear to be long the average added cost for extras rarely prohibits the use of the steel for the purpose in mind.

## COMPARATIVE PRICES OF STAINLESS STEELS

| Type No. | Carbon | Chrome | Nickel | Other Elements | Bars Drawn Wire Structurals | Plates | Sheets | Hot Rolled Strip | Cold Rolled Strip | Forging Billets |
|---|---|---|---|---|---|---|---|---|---|---|
| 301 | .09-.20 | 16.00-18.00 | 7.00- 9.00 | Mn. 1.25 Max. | 24c | 27c | 34c | 20¼c | 25½c | 20.40c |
| 302 | Over .08-.20 | 17.50-20.00 | 8.00-10.00 | Mn. 1.25 Max. | 24c | 27c | 34c | 21½c | 28c | 20.40c |
| 302B | Over .08 | 17.50-20.00 | 8.00-10.00 | Si 2.00-3.00 Mn 1.25 Max. | 24c | 27c | 34c | 21½c | 28c | 20.40c |
| 303 | .20 Max. | 17.50-20.00 | 8.00-10.00 | S or Se .07 Min or Mo .60 Max. | 26c | 29c | 36c | 27c | 33c | 22.10c |
| 304 | .08 Max. | 18.00-20.00 | 8.00-10.00 | Mn. 2.00 Max. | 25c | 29c | 36c | 23½c | 30c | 21.25c |
| 305 | .08 Max. | 19.00-22.00 | 10.00-12.00 | Mn. 2.00 Max. | 29c | 34c | 41c | 28½c | 35c | 24.65c |
| 309 | .20 Max. | 22.00-26.00 | 12.00-14.00 | | 36c | 40c | 47c | 37c | 47c | 30.60c |
| 309S | .08 Max. | 22.00-26.00 | 12.00-14.00 | | 40c | 44c | 51c | 41c | 51c | 34.00c |
| 310 | .25 Max. | 24.00-26.00 | 19.00-21.00 | | 49c | 52c | 53c | 48¾c | 56c | 41.65c |
| 311 | .25 Max. | 19.00-21.00 | 24.00-26.00 | | 49c | 52c | 53c | 48¾c | 56c | 41.65c |
| 312 | .25 Max. | 27.00-31.00 | 8.00-10.00 | | 36c | 40c | 49c | .... | .... | 30.60c |
| 315 | .15 Max. | 17.00-19.00 | 7.00- 9.50 | Cu. 1.00-1.50 Mo 1.00-1.50 | 36c | 42c | 46c | .... | .... | .... |
| 316 | .10 Max. | 16.00-18.00 | 10.00-14.00 | Mo 2.00-3.00 | 40c | 44c | 48c | 40c | 48c | 34.00c |

## COMPARATIVE PRICES OF STAINLESS STEELS (Continued)

| Type No. | Carbon | Chrome | Nickel | Other Elements | Bars Drawn Wire Structurals | Plates | Sheets | Hot Rolled Strip | Cold Rolled Strip | Forging Billets |
|---|---|---|---|---|---|---|---|---|---|---|
| 317 | .10 Max. | 18.00-20.00 | 10.00-14.00 | Mo 3.00-4.00 | 50c | 54c | 58c | 50c | 58c | 42.50c |
| 321 | .10 Max. | 17.00-20.00 | 7.00-10.00 | Ti Min 4xC | 29c | 34c | 41c | 29¼c | 38c | 24.65c |
| 325 | .25 Max. | 7.00-10.00 | 19.00-23.00 | Cu 1.00-1.50 | 26c | 30c | 37c | 26¼c | 34c | 22.10c |
| 327 | .25 Max. | 25.00-30.00 | 3.00- 5.00 | | 31c | 36c | 42c | 30¾c | 41c | 26.35c |
| 329 | .10 Max. | 25.00-30.00 | 3.00- 5.00 | Mo 1.00-1.50 | 36c | 40c | 44c | 36c | 45c | 30.60c |
| 330 | .25 Max. | 14.00-16.00 | 33.00-36.00 | | 49c | 52c | 53c | .... | .... | 41.65c |
| 347 | .10 Max. | 17.00-20.00 | 8.00-12.00 | Cb 10xC | 33c | 38c | 45c | 33c | 42c | 28.05c |
| 403 | .15 Max. | 11.50-13.00 | ..... | Turbine Quality | 21½c | 24½c | 29½c | 21¾c | 27c | 18.275c |
| 405 | .08 Max. | 11.50-13.50 | ..... | Al .10-.20 | 20c | 23c | 28c | 19¾c | 25½c | 17.00c |
| 406 | .15 Max. | 12.00-14.00 | ..... | Al 4.00-4.50 | 23c | 26c | 31c | 22¾c | 31c | 19.55c |
| 410 | .15 Max. | 10.00-14.00 | ..... | | 18½c | 21½c | 26½c | 17c | 22c | 15.725c |
| 414 | .15 Max. | 10.00-14.00 | 2.00 Max. | | 18½c | 21½c | 26½c | 17c | 22c | 15.725c |
| 416 | .15 Max. | 12.00-14.00 | ..... | S or Se .07 Min or Mo .60 Max. | 19c | 22c | 27c | 18¼c | 23½c | 16.15c |
| 418 | .15 Max. | 12.00-14.00 | ..... | W 2.50-3.50 | Prices quoted upon application | | | | | |
| 420 | Over .15 | 12.00-14.00 | ..... | | 24c | 28½c | 33½c | 23¾c | 36½c | 20.40c |
| 420F | Over .15 | 12.00-14.00 | ..... | S or Se .07 Min or Mo .60 Max. | 24½c | .... | .... | .... | .... | .... |
| 430 | .12 Max. | 14.00-18.00 | ..... | | 19c | 22c | 29c | 17½c | 22½c | 16.15c |
| 430F | .12 Max. | 14.00-18.00 | ..... | S or Se .07 Min or Mo .60 Max. | 19½c | 22½c | 29½c | 18¾c | 24½c | 16.575c |
| 431 | .15 Max. | 14.00-18.00 | 2.00 Max. | | 19c | 22c | 29c | 17½c | 22½c | 16.15c |
| 438 | .12 Max. | 16.00-18.00 | ..... | W 2.50-3.50 | Prices quoted upon application | | | | | |
| 439 | .50-.65 | 8.00 | ..... | W 8.00 | Prices quoted upon application | | | | | |
| 440 | Over .12 | 14.00-18.00 | ..... | | 24c | 28½c | 33½c | 23¾c | 36½c | 20.40c |
| 441 | Over .15 | 14.00-18.00 | 2.00 Max. | | 24c | 28½c | 33½c | 23¾c | 36½c | 20.40c |
| 442 | .35 Max. | 18.00-23.00 | ..... | | 22½c | 25½c | 32½c | 24c | 32c | 19.125c |
| 446 | .35 Max. | 23.00-30.00 | ..... | | 27½c | 30½c | 36½c | 35c | 52c | 23.375c |
| 501 | Over .10 | 4.00-6.00 | ..... | | 8c | 12c | 15¾c | 12c | 17c | 7.20c |
| 502 | .10 Max. | 4.00-6.00 | ..... | | 9c | 13c | 16¾c | 13c | 18c | 8.10c |

When carbon content .11 or under is specified or required in Types 301, 302 and 302B, the price of Type 304 applies.
No specific composition limits within the above ranges may be placed on Types 301, 302, 302B and 303 except that carbon may be specified to a four point range within the above limits.

# GLASS, GLASS-LINED AND FUSED SILICA

### PHYSICAL PROPERTIES OF LOW-EXPANSION GLASSES, FUSED QUARTZ AND FUSED SILICA

| MATERIAL | Specific Gravity | Specific Volume, Cu. in. per lb. | Tensile Strength, Lb. per sq. in. | Modulus of Elasticity, Lb. per sq. in. (Multiply by $10^6$) | Hardness* | Thermal Expansion Per °C. (Multiply by $10^{-6}$) | Thermal Cond., Cal. per sec., cm.², °C., cm. (Multiply by $10^{-4}$) | Specific Heat, Cal. per °C., gm. | Softening Point, °F. | Breakdown Voltage, 60 cycles, v. per mil | Dielectric Constant, 60 cycles | Refractive Index, $n_{AD}$ | Transparency† | Forms Available** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Borosilicate glass | 2.23 | 12.4 | 10,000 | 98 | .... | 0.32 | 24.5 | 0.20 | 1,505 | 3,200(0.1 in.) | 4.6 | 1.47 | T, TL | S, R, T, other |
| 96% silica glass | 2.18 | 12.7 | ..... | ..... | .... | 0.080 | .... | ..... | 2,750±90 | 3,000 | 4.0 Approx. | 1.458 | T | R, T, other |
| Fused quartz | 2.20 | 12.6 | 4,000 | 105-126 | 4.9 | 0.054 | 35 | 0.25 | 2,600 | 500 (¼ in.) | 3.8 | 1.459 | T | S, R, T, other |
| Fused silica | 2.07 | 13.4 | 400-800 | 94-114 | .... | 0.054 | 25 | ..... | 2,600 | 250 (¼ in.) | 3.7 | .... | TL, O | S, R, T, other |

* Hardness: 2.5 mm. ball, 25 kg. load, depth in 1/200 mm. † T = transparent; TL = translucent; O = opaque. ** S = sheets; R = rods; T = tubes.

### MAKERS OF GLASS, GLASS-LINED AND FUSED SILICA EQUIPMENT

| MANUFACTURER (Name and Address) | Composition, Forms Available | MANUFACTURER (Name and Address) | Composition, Forms Available |
|---|---|---|---|
| Alsop Engineering Co., Milldale, Conn. | Glass-lined steel tanks and mixers | Hanovia Chemical & Mfg. Co., Newark, N. J. | Transparent fused quartz in all shapes |
| Amersil Corp., Hillside, N. J. | Fused silica ware such as pans, pipes, gas coolers, absorbers | Metal-Glass Products Co., Belding, Mich. | Glass-enameled steel equipment |
| Corning Glass Works, Corning, N. Y. | Special heat- and corrosion-resisting borosilicate glass supplied in various forms: pipe, columns, etc. Also 96 per cent high silica glassware now available for laboratory use | Owens-Corning Fiberglas Corp., Toledo, Ohio | Fibrous glass filter cloths and dust filters |
| | | The Pfaudler Co., Rochester, N. Y. | Wide variety of standard and special glass-enameled steel equipment — various formulas |
| | | A. O. Smith Corp., Milwaukee, Wis. | Glass-enameled steel equipment |
| Ertel Engineering Co., New York, N. Y. | Glass-enameled tanks | The Thermal Syndicate, Brooklyn, N. Y. | Fused silica (non-transparent) supplied in various large forms; fused quarts (transparent) in smaller sizes |
| General Electric Co., Schenectady, N. Y. | Transparent fused quarts in various small sized articles | Vitreous Enameling & Stamping Co., New York, N. Y. | Enameled specialties, tanks |
| Glascote Products, Inc., Euclid, Ohio | Glass-enameled steel equipment | | |

# CHEMICAL STONEWARE, PORCELAIN, CEMENTS

## PHYSICAL PROPERTIES OF CHEMICAL STONEWARE AND PORCELAINWARE

### Chemical Stoneware

The accompanying table, which has been prepared for us by the General Ceramics Co., gives the physical properties of an average grade of chemical stoneware. It should be emphasized here that "chemical stoneware" is not the name of a definite material, such as an alloy, but a generic term applied to a wide variety of ceramic compositions, and hence that in any particular composition designed to give optimum properties in one respect, it will ordinarily be impossible to secure optimum properties in all other respects.

| | | | |
|---|---|---|---|
| Specific gravity | 2.2 | Modulus of elasticity, lb. per sq. in. | 8,000,000 |
| Hardness, scleroscope | 100 | Specific heat | 0.2 |
| Ultimate tensile strength, lb. per sq. in. | 2,000 | Thermal cond., B.t.u. per hr., sq. ft., °F., in. | 10.0 |
| Ultimate compressive strength, lb. per sq. in. | 80,000 | Linear thermal expansion, per °F. | 0.0000020 |
| Modulus of rupture, lb. per sq. in. | 5,000 | Water absorption, per cent | 0–4 |

### Chemical Porcelainware

Data supplied by Lapp Insulator Co.

| | |
|---|---|
| Specific gravity | 2.41 |
| Ultimate tensile strength, lb. per sq. in. | 5,–8,000 |
| Ultimate compressive strength, lb. per sq. in. | 100,000 |
| Modulus of rupture, lb. per sq. in | 12,–15,000 |
| Modulus of elasticity, lb. per sq. in. | 10,400,000 |
| Specific heat | 0.2 |
| Thermal cond., B.t.u. per hr., sq. ft., °F., in | 8.4 |
| Linear thermal expansion, per °F | 0.0000023 |
| Water absorption, per cent | 0 |

## MAKERS OF CHEMICAL STONEWARE, PORCELAIN, ACIDPROOF BRICK AND STONE

| MANUFACTURER (Name and Address) | Materials |
|---|---|
| **Chemical Stoneware** | |
| General Ceramics Co., New York, N. Y. | Complete line, see note below |
| Maurice A. Knight, Akron, Ohio | Complete line, see note below |
| United States Stoneware Co., Akron, Ohio | Complete line, see note below |
| **Chemical Porcelain** | |
| Coors Porcelain Co., Golden, Colo. | Porcelain laboratory ware |
| Lapp Insulator Co., LeRoy, N. Y. | Chemical porcelain ware of all types |
| **Acidproof Brick and Other** | |
| Acme Brick Co., Fort Worth, Tex. | Acidproof brick |
| Alabama Clay Products Co., Birmingham, Ala. | Acidproof brick |
| Alberene Stone Corp. of Va., New York, N. Y. | Acidproof stone |
| Atlas Mineral Products Co., Mertztown, Pa. | Acidproof brick construction |
| Belden Brick Co., Canton, Ohio | Acidproof brick |
| Buckeye Pottery Co., Macomb, Ill. | Acidproof ceramics |
| Charlotte Chemical Labs., Charlotte, N. C. | Acidproof brick, rings |
| Claycraft Co., Columbus, Ohio | Acidproof brick |
| Custodis Construction Co., New York, N. Y. | Acidproof brick construction, towers, tanks |
| Electro-Chemical Supply & Engineering Co. Paoli, Pa. | Acidproof brick and masonry construction |
| Filtros, Inc., East Rochester, N. Y. | Acidproof mineral as plates, cylinders, etc. |
| General Refractories Co., Philadelphia, Pa. | Acidproof tower packing, brick |
| Harbison-Walker Refractories Co. Pittsburgh, Pa. | Acidproof brick |
| B. Mifflin Hood Co., Daisy, Tenn. | Acidproof brick tower packings, flooring tiles |
| Ironton Fire Brick Co., Ironton, Ohio | Acidproof brick |
| Keagler Brick Co., Steubenville, Ohio | Acidproof brick |
| Kewaunee Mfg. Co., Kewaunee, Wis. | Karcite acidproof ceramic ware |
| Laclede-Christy Clay Prod. Co., St. Louis, Mo | Acidproof brick |
| McLain Fire Brick Co., Pittsburgh, Pa. | Acidproof brick |
| McLeod & Henry Co., Troy, N. Y. | Acidproof brick |
| Metropolitan Paving Brick Co., Canton, Ohio. | Acidproof brick |
| National Carbon Co., Inc., Cleveland, Ohio. | Carbon brick |
| Nukem Products Corp., Buffalo, N. Y. | Acidproof brick (see Keagler) |
| Parker-Russell Mining & Mfg. Co., St. Louis, Mo. | Acidproof brick |
| Patterson Foundry & Machine Co., East Liverpool, Ohio | Acidproof lining blocks and grinding balls |
| Quigley Co., New York, N. Y. | Acidproof brick |
| Robinson Clay Product Co. of N. Y., New York, N. Y. | Acidproof and vitrified sewer tile |
| Southern Clay Mfg. Co., Chattanooga, Tenn. | Acidproof brick |
| Thornton Fire Brick Co., Clarksburg, W. Va. | Acidproof brick |
| Uhl Pottery Co., Huntington, Ind. | Acidproof ceramics |

Note: Makers of complete lines of chemical stoneware supply such equipment as acid plants; ball mills; brick and tile; blowers and exhausters; coils; filters; acid-proof laboratory sinks, drain and vent lines; jars; jugs; kettles; pipe, fittings and valves; stills; tourills; towers, tower linings and tower packings; and many types of special equipment.

## MAKERS OF CEMENTS AND PUTTIES FOR ACIDPROOF BRICK AND STONEWARE

| MANUFACTURER (Name and Address) | Trade Names | Compositions, Applications, Types |
|---|---|---|
| Anti-Hydro Waterproofing Co., Newark, N. J. | Anti-Hydro | Water-, acid-, alkali-, oil-resisting concrete mix |
| Atlas Lumnite Cement Co., New York, N. Y. | Lumnite cement | Cement for corrosion and temp.-resistant concrete |
| Atlas Mineral Products Co., Mertztown, Pa. | Tegul-Vitrobond,-Mineralead, Tileset, Kores, G. K., others | Thiokol-sulphur-base, chemical-setting silicate and resin-base and other cements for all acidproof construction |
| Charlotte Chemical Labs., Charlotte, N. C. | Charlab, Acipruf, Carolina | Standard and chemical-setting silicate cements; acidproof putty |
| Chemical Construction Corp., New York, N. Y. | Acipruf | Acidproof cement |
| Custodis Construction Co., Inc., New York, N. Y. | Custodis resin cement, Penchlor, Asplit | Synthetic resin, sodium silicate & phenolic base cements, resp. |
| Electro-Chemical Supply & Engineering Co., Paoli, Pa. | Duro Standard, Triple X | Cements for all acid conditions; also water and steam |
| Filtros, Inc., East Rochester, N. Y. | Filtros | Acidproof cement |
| General Ceramics Co., New York, N. Y. | Acidproof Nos. 1, 6, 7, 8 | Silicate cements and linseed oil- and asphalt-base putties |
| B. F. Goodrich Rubber Co., Akron, Ohio | Plastikon | Rubber-base putty |
| The Haveg Corp., Newark, Del. | Havegit 41, 43 | Self-hardening phenolic resin cements for acids |
| M. W. Kellogg Co., New York, N. Y. | ..... | Acidproof cement |
| Maurice A. Knight, Akron, Ohio | Knight | Silicate cements for strong acids |
| Nukem Products Co., New York, N. Y. | Basolit, Nu-Mastic asphalt, Plasul-Basolit | Sulphur-base cement for acids, resin cements |
| Paraffine Cos., San Francisco, Calif. | ..... | Acidproof cement |
| Patterson Foundry & Machine Co., East Liverpool, Ohio. | Porox Cement | Silicate cement for strong acids |
| Pecora Paint Co., Philadelphia, Pa. | Acitite, Acichlor, Cushion Putty | Slow- and quick-drying cements and elastic putties for acids |
| Pennsylvania Salt Mfg. Co., Philadelphia, Pa. | Penchlor acid-proof cement, Asplit, Causplit | Chemical-setting silicate cement for acids; self-hardening resin cements for acids and alkalis |
| Philadelphia Quartz Co., Philadelphia, Pa. | "S" Brand and N38 Special Sodium Silicates | Sodium silicates for regular and quick-setting acidproof cements |

## MAKERS OF CEMENTS AND PUTTIES (Continued)

| MANUFACTURER | Trade Names | Compositions, Applications, Types |
|---|---|---|
| Quigley Co., New York, N. Y. | Acidproof Nos. 1 and 2 | Silicate cements for acid gases and mineral acids |
| Reardon Cement Co., Cincinnati, Ohio | Bedford | Acid and alkali resisting cements and plastics |
| The Sullivan Co., Memphis, Tenn. | Acidol, Sulsilo | Pouring cements and pre-mixed silicate cements for strong acids |
| Sauereisen Cements Co., Sharpsburg, Pa. | Inss-Lute Nos. 31, 48, 46, 44 | Quick-setting, air-drying, sulphur and bitumastic cements |
| United States Stoneware Co., Akron, Ohio | U. S. Standard, Pre-Mixt, Calktite and others | Silicate cements of all types, resin cements, putties, etc. |

# CORROSION-RESISTANT PLASTICS

## REPRESENTATIVE MAKERS OF MOLDING AND CASTING RESINS FOR CHEMICAL PLANT USE

| MANUFACTURER | Trade Name and Type |
|---|---|
| **MOLDING AND EXTRUSION MATERIALS** | |
| American Cyanamid Co., New York, N. Y. | **Melamac,** melamine |
| Bakelite Corp.*, New York, N. Y. | **Bakelite,** phenolic and polystyrene |
| Carbide & Carbon Chem. Corp.*, New York | **Vinylite,** vinyl chloride and acetate |
| Continental Diamond Fibre Co., Newark, Del. | **Celoron,** phenolic |
| Dow Chemical Co., Midland, Mich. | **Ethocel,** ethyl cellulose<br>**Styron,** polystyrene<br>**Saran,** vinylidene chloride |
| E. I. duPont de Nemours & Co., Wilmington, Del. | **Lucite,** methacrylate |
| Durez Plastics & Chem. Inc., N. Tonawanda, N. Y. | **Durez,** phenolics |
| General Electric Co., Pittsfield, Mass. | **Textolite,** phenolic |
| Hercules Powder Co., Wilmington, Del. | **Hercules,** ethyl cellulose |
| Heresite & Chemical Co., Manitowoc, Wis. | **Heresite,** phenolic |
| Irvington Varnish & Ins. Co., Irvington, N. J. | **Cardolite,** cashew nut derivative |
| Monsanto Chemical Co., Indian Orchard, Mass. | **Monsanto,** polystyrene<br>**Resinox,** phenolic |
| Reichhold Chemicals, Inc., Detroit, Mich. | **Beckacite,** phenolics |
| Reilly Tar & Chemical Co., Indianapolis, Ind. | **Indur,** phenolic |
| Rohm & Haas Co., Philadelphia, Pa. | **Crystalite,** acrylate |
| **CAST RESINOIDS** | |
| Bakelite Corp.*, New York, N. Y. | **Bakelite,** phenolic |
| Catalin Corp., New York, N. Y. | **Catalin,** phenolic |
| E. I. duPont de Nemours & Co., Wilmington, Del. | **Lucite,** methacrylate |
| Haveg Corp., Newark, Del. | **Haveg,** phenolic equipment |
| Marblette Corp., Long Island City, N. Y. | **Marblette,** phenolic |
| Monsanto Chemical Co., Indian Orchard, Mass. | **Monsanto,** phenolic |
| Rohm & Haas Co., Philadelphia, Pa. | **Plexiglas,** acrylate |

* Unit of Union Carbide & Carbon Corp.

# REFRACTORY MATERIALS

## PHYSICAL PROPERTIES OF REFRACTORY MATERIALS

(Complete revision of earlier Chem. & Met. data, compiled by I. J. Trostel, General Refractories Co., Baltimore)

| Type of Brick | Silica | High Heat Duty (No. 1) Fireclay | High Heat Duty (No. 1) Kaolin | Super Duty Fireclay | Alumina-Diaspore, 70 PerCent $Al_2O_3$ | Silli-manite (Mullite) | Chrome | Unburned Chrome | Magne-site | Unburned Magne-site | Bonded Silicon Carbide (Grade A) | Bonded Fused Alumina | Insul. Firebrick (2,600°F.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Typical composition, per cent** | | | | | | | | | | | | | |
| $SiO_2$ | 96 | 50-57 [1] | 53 | 52 [1] | 22-26 | 35 | 6 | 5 | 3 | 5 | 7-9 | 8-10 | 50-57 |
| $Fe_2O_3$ | 1 | 1.5-2.5 | 2 | 1 | 1-1.5 | 0.5 | ..... | ..... | 6 | 8.5 | 0.3-1 | 1-1.5 | 1.5-2.5 |
| FeO | ..... | ..... | ..... | ..... | ..... | ..... | 15 | 12 | ..... | ..... | ..... | ..... | ..... |
| $Al_2O_3$ | 1 | 36-42 | 42 | 43 | 68-72 | 62 | 23 | 18 | 2 | 7.5 | 2-4 | 85-90 | 36-42 |
| $TiO_2$ | ..... | 1.5-2.5 | 2 | 2 | 3.5 | 1.5 | ..... | ..... | ..... | ..... | 1 | 1.5-2.2 | 1.5-2.5 |
| CaO | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3 | 2 | ..... | ..... | ..... |
| MgO | ..... | ..... | ..... | ..... | ..... | ..... | 17 | 32 | 86 | 64 | ..... | ..... | ..... |
| $Cr_2O_3$ | ..... | ..... | ..... | ..... | ..... | ..... | 38 | 30 | ..... | 10 | ..... | ..... | ..... |
| SiC | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 85-90 | ..... | ..... |
| Flux [2] | ..... | 1-3.5 | 1 | 2 | 1-1.5 | 0.5 | ..... | ..... | ..... | ..... | 1.5 | 0.8-1.3 | 1-3.5 |
| P.C.E. (with approx. equivalent temp., °F.) [3] | 31-32 (3,056-3,092°) | 31-33 (3,056-3,173°) | 33-34 (3,173-3,200°) | 33-34 (3,173-3,200°) | 36-37 (3,290°) | 37-38 (3,308-3,335°) | 41+ (3,578°+) | 41+ (3,578°+) | 41+ (3,578°+) | 41+ (3,578°+) | 39 (3,389°) | 39+ (3,389°+) | 29-30 (2,984-3,002°) |
| Deformation under load, [4] per cent (at lb. per sq. in. and temp., ° F., shown) | Shears 25 p.s.i. 2,900° | 2.5-10* 25 p.s.i 2,460° | 6-7 25 p.s.i. 2,640° | 2-4† 25 p.s.i. 2,640° | 1-4† 25 p.s.i. 2,640° | 0.0-0.5† 25 p.s.i. 2,640° | Shears 28 p.s.i. 2,740° | Shears 28 p.s.i. 2,955° | Shears 28 p.s.i. 2,765° | Shears 28 p.s.i. 2,940° | 0-1 50 p.s.i. 2,730° | 1 50 p.s.i. 2,730° | 0.3 10 p.s.i. 2,200° |
| Resistance to spalling, per cent [5] | Poor | 5-20 | 5-15 | 0-4 | No loss | No loss | Poor | Fair | Poor | Fair | Good | Good | Good |
| Permanent linear change on re-heating [6] (after 5 hr. at temp., °F., shown) | (+) 0.5-.8 2,640° | (±) 0-1.5 2,550° | (−)0-1.5 2,550° | (±) 0-1.5 2,910° | (−) 2-4 2,910° | (−) 0-0.8 2,910° | (−) 0.5-1 3,000° | (−)0.5-1.0 3,000° | (−) 1-2 3,000° | (−)0.5-1.5 3,000° | (+) 2 [8] 2,910° | (+) 0.5 2,910° | (−) 1.5 [8] 2,550° |
| Porosity (as open pores), per cent | 20-30 | 15-25 | 24-28 | 12-15 | 27-36 | 20-25 | 20-26 | 10-12 | 20-26 | 10-12 | 13-28 | 20-26 | 75 |
| Weight per brick (std. 9 in. straight), lb. | 6-6.5 | 7.5 | 7-7.5 | 8.5 | 7.5-8.5 | 8.5 | 11 | 11.3 | 10 | 10.7 | 8-9.3 | 9-10.6 | 2.25-3 |
| Specific heat (60-1,200°F.) | 0.23 | 0.23 | 0.22 | 0.23 | 0.23 | 0.23 | 0.20 | 0.21 | 0.27 | 0.26 | 0.20 | 0.20 | 0.22 |
| **Relative slag resistance** [7] | | | | | | | | | | | | | |
| Acid steel slag | Good | Fair | Fair | Fair | Good | Good | Poor | Poor | Poor | Poor | Good | Good | Poor |
| Basic steel slag | Poor | Poor | Poor | Poor | Fair | Fair | Good | Good | Good | Good | Good | Good | Poor |
| Mill scale | Fair | Poor | Fair | Good | Fair | Fair | Good | Good | Good | Good | Fair | Fair | Poor |
| Coal ash slag | Poor | Fair | Fair | Fair | Fair | Fair | Fair | Fair | Good | Good | Good | Good | Poor |

[1] Higher in some districts. [2] Includes CaO + MgO + alkalis. [3] Pyrometric Cone Equivalent; terms "fusion," "softening," "deformation," and "melting" points heretofore loosely used. [4] Data marked (*) are from A.S.T.M. test C 16-36 with High Heat Duty time-temperature schedule; those marked (†) are from same test with Super Duty time-temperature schedule; others determined by other commonly used tests. [5] (+) means expansion; (−) means shrinkage. [6] Oxidizing atmosphere. [7] Ratings affected somewhat by varying temperatures and type of atmosphere prevailing. Resistance to coal ash slag affected by furnace temperature as well as analysis and fusion point of slag. [8] After 24 hr. [9] Loss in appropriate A.S.T.M. Panel Test.

## REPRESENTATIVE MAKERS OF REFRACTORIES AND HIGH TEMPERATURE MORTARS

| MANUFACTURER | Principal Types |
|---|---|
| Acme Brick Co., Ft. Worth, Tex | Firebrick and clay, h.t. cements, plastic refrs. |
| Alberene Stone Corp. of Va., New York, N. Y. | Refractory linings |
| American Crucible Co., Shelton, Conn | Graphite crucibles, silica and mullite refrs. |
| Armstrong Cork Co., Lancaster, Pa | Refr. insul. brick, h.t. mortars, 1,800 deg. insul. block and cement |
| Atlas Lumnite Cement Co., New York, N. Y. | Cement for refr., heat-resisting and insul. concrete |
| Babcock & Wilcox Co., New York, N. Y | Glass plant refrs., h.t. mortars, plastic refrs., insulating and kaolin refrs. |
| Bartley Crucible & Refr. Co., Trenton, N. J. | Graphite crucibles, firebrick, magnesite refrs. |
| Betson Plastic Fire Brick Co., Buffalo, N. Y. | H.t. mortars, plastic refrs. |
| Botfield Refractories Co., Philadelphia, Pa | Chrome, firebrick, plastic refrs., h.t. mortars |
| Philip Carey Co., Lockland, Ohio | H.t. mortars, insulations |
| Carborundum Co., Perth Amboy, N. J | Silicon carbide, aluminum oxide, mullite and fused cast refrs. and h.t. mortars |
| Champion Spark Plug Co., Detroit, Mich | Sillimanite plastic refrs., electric furnace refrs. |
| Corhart Refractories Co., Louisville, Ky | H.t. mortars, electro-cast mullite refrs. |
| Corundite Refractories, Inc., Massillon, Ohio | Firebrick, h.t. mortars, plastic refrs, alumina, silica and mullite refrs. |
| Denver Fire Clay Co., Denver, Colo | Firebrick, diaspore and sillimanite refrs., h.t. mortars, plastic refrs., fireclays |
| W. S. Dickey Clay Mfg. Co., Kansas City, Mo. | Fireclay refrs. |
| Joseph Dixon Crucible Co., Jersey City, N. J. | Graphite crucibles |
| Ehret Magnesia Mfg. Co., Valley Forge, Pa. | H.t. mortar |
| Electro Refrs. & Alloys Corp., Buffalo, N. Y. | Mullite, fused alumina, silicon carbide and magnesia refrs |
| Emsco Refractories Co., Vernon, Calif | Firebrick, glass plant refrs., h.t. mortars |
| The Exolon Co., Blasdell, N. Y | Silicon carbide, alumina refrs. |
| General Abrasive Co., Niagara Falls, N. Y | Alumina and silicon carbide |
| General Ceramics Co., New York, N. Y | Special refrs. |
| General Refractories Co., Philadelphia, Pa | Fired and unfired chrome and magnesite, firebrick, h.t. mortars, plastic and silica refrs. |
| Gladding, McBean & Co., Los Angeles, Calif. | Firebrick, insul. brick and plastics, h.t. mortars, plastic refrs., fireclays |
| A. P. Green Fire Brick Co., Mexico, Mo | Firebrick, insul. f.b., h.t. mortars, plastic and castable refrs., fireclays |
| Harbison-Walker Refrs. Co., Pittsburgh, Pa. | Refrs. of most types incl. reg. and super fireclay, high-alumina, silica, chrome, magnesite, Fosterite brick; clays; insul. firebrick and mortars; h.t. mortars |
| Haws Refractories Co., Johnstown, Pa | Firebrick of all kinds, silica brick, fireclays |
| Illinois Clay Products Co., Joliet, Ill | Firebrick, h.t mortars, insulating cements coatings and brick |
| Ironton Fire Brick Co., Ironton, Ohio | Fireclay refrs., refr. cements, fireclays |
| Johns-Manville, New York, N. Y | Bonding mortars, castables, ramming mixtures, plastic and insul. refrs. |
| Laclede-Christy Clay Prod. Co., St. Louis, Mo. | Firebrick, h.t. mortars, plastic refrs., glass plant refrs., fireclays |
| E. J. Lavino & Co., Philadelphia, Pa | Chrome and magnesite refrs., h.t. mortars, silica refrs., fireclays |
| Massillon Refractories Co., Massillon, Ohio | Firebrick, h.t. mortars, plastic refrs., special compositions |
| McLain Fire Brick Co., Pittsburgh, Pa | Various |
| McLeod & Henry Co., Troy, N. Y | Firebrick, h.t. mortars, plastic refrs., fireclays |
| Mullite Refractories Co., Shelton, Conn | H.t. mortars, plastic refrs., mullite refrs. |
| National Carbon Co., Inc., Cleveland, Ohio | Carbon refrs. |
| Niles Fire Brick Co., Niles, Ohio | Firebrick, insulating refrs. |
| North American Refrs. Co., Cleveland, Ohio | Fireclay, super, insul. and silica brick, h.t. mortars, plastic refrs., fireclays |
| Norton Co., Worcester, Mass | H.t. mortars, silicon carbide, fused alumina and magnesia, raw materials, cements, refr. shapes |
| Pacific Clay Products Co., Los Angeles, Calif. | Plastic refrs. |
| Pyro Clay Products Co., Oak Hill, Ohio | Glass plant refrs. |
| Quigley Co., Inc., New York, N. Y | Firebrick, insulating refrs., super firebrick, h.t. mortars, plastic refrs. |
| Ramtite Co., Chicago, Ill | H.t. mortars |
| Refractory&Insulation Corp., NewYork, N. Y | H.t. mortars |
| Robinson Clay Product Co. of N. Y., New York, N. Y | H.t. mortars, firebrick and clay, insulating refrs. |
| Ross Tacony Crucible Co., Philadelphia, Pa | Graphite crucibles and stopper heads, magnesite refrs. |
| St. Louis Fire Brick & Insulation Co., Huntington Park, Calif | Various |
| Seaboard Refrs. Co., Perth Amboy, N. J | Firebrick, h.t. mortars, plastic and insulating refrs., silicon carbide and mullite refrs. |
| Chas. Taylor Sons Co., Cincinnati, Ohio | Firebrick, glass plant and insulating refrs., sillimanite |
| The United States Stoneware Co., Akron, Ohio | Plastic and castable refrs. |
| M. D. Valentine & Bro. Co., Woodbridge, N. J. | Firebrick |
| Vitrefrax Corp., Los Angeles, Calif | Glass plant refrs. firebrick, h.t. mortars, plastic refrs., fireclays |

# STRUCTURAL CARBON AND GRAPHITE

## CHEMICAL RESISTANCE OF IMPERVIOUS CARBON AND IMPERVIOUS GRAPHITE

| Resistant to These Reagents | Concentration Per cent | Temp. Deg. C. |
|---|---|---|
| Acetic acid | Glacial | B. Pt. |
| Acetic anhydride | 100 | B. Pt. |
| Acetone | 100 | B. Pt. |
| Air | ... | 175 |
| (S) Air | ... | 200 |
| Ammonia | 20 | R. T. |
| Ammonium thiocyanate | 25 | 95 |
| Amyl alcohol | 100 | B. Pt. |
| Aniline | 100 | 110 |
| Arsenic acid | 75 | 125 |
| Benzene | 100 | B. Pt. |
| Boric acid | 25 | B. Pt. |
| (S) Bromine water | Sat'd. | 65 |
| Butyl alcohol | 100 | B. Pt. |
| Butyl cellosolve | 100 | 110 |
| Camphor | .08 | 50 |
| Camphor and | .08 | 50 |
| Sodium hydroxide | 3 | 50 |
| Carbon dioxide — water | Sat'd. | to 100 |
| Carbon monoxide — water | Sat'd. | to 100 |
| Carbon tetrachloride | 100 | B. Pt. |
| Cellosolve | 100 | 110 |
| Cellosolve | 25 | 110 |
| (S) Chlorethylbenzene | Tech. | 125 |
| Chlorine, dry | Gas | R. T. |
| (S) Chlorine water | Sat'd. | R. T. |
| Chloroform | 100 | B. Pt. |
| Citric acid | 25 | B. Pt. |
| Cupric chloride | 10 | 95 |
| Dioxan | 100 | B. Pt. |
| Ethyl alcohol | 95 | B. Pt. |
| Ethyl mercaptan — water | Sat'd. | to 100 |
| Ethylene dichloride | 100 | B. Pt. |
| Ferric chloride | 15 | to B. Pt. |
| (S) Ferric chloride | 25 | B. Pt. |
| Ferrous chloride | 40 | B. Pt. |
| Ferrous sulphate | 25 | B. Pt. |
| Formic acid | 90 | B. Pt. |
| Formic acid and | 3 | 70 |
| Potassium dichromate | 1 | 70 |
| Freon - 11 ($CFCl_3$) | 100 | R. T. |
| Freon - 12 ($CF_2Cl_2$) | 100 | R. T. |
| Gasoline | 100 | B. Pt. |
| Glycerine | 100 | 135 |
| Hydrobromic acid | 40 | B. Pt. |

(Continued next page)

## STRUCTURAL CARBON AND GRAPHITE (Continued)

| Resistant to These Reagents | Concentration Per cent | Temp. Deg. C. |
|---|---|---|
| *(Continued from preceding page)* | | |
| Hydrochloric acid | 20 | B. Pt. |
| Hydrofluoric acid | 15 | B. Pt. |
| Hydrogen peroxide and | 8 | |
| Mercuric nitrate and | 10 | R. T. |
| Nitric acid | 5 | |
| Hydrogen sulphide — water | Sat'd. | to 100 |
| Isopropyl acetate | 100 | B. Pt. |
| Isopropyl alcohol | 100 | B. Pt. |
| Isopropyl ether | 100 | B. Pt. |
| Kerosene | 100 | to 160 |
| Lactic acid | 25 | B. Pt. |
| Manganous sulphate | 15 | 95 |
| Mannitol | 25 | B. Pt. |
| Methyl alcohol | 100 | B. Pt. |
| Methyl isobutyl ketone | 100 | B. Pt. |
| Monochlorbenzene | 100 | B. Pt. |
| Monoethanolamine | 10 | 96 |
| Nickel chloride $6H_2O$ and | 300 g./l. 30 g./l. | 50 |
| Boric acid | 30 g./l. | 50 |
| Nickel sulphate $6H_2O$ and | 318 g./l. | |
| Nickel chloride $6H_2O$ and | 16.5 g./l. | 75 |
| Boric acid | 30 g./l. | |
| (S) Nitric acid | 2 | R. T. |
| (S) Nitric acid | 10 | R. T. |
| Nitrobenzene | 100 | 135 |
| Octyl alcohol | Tech. | B. Pt. |
| Oleic acid | 100 | 135 |
| Oxalic acid | 25 | 135 |
| Oxalic acid and | Sat'd. | R. T. |
| Nitric acid | 0.3 | R. T. |
| Paraldehyde | 100 | 110 |
| Paraldehyde — water | Sat'd. | 110 |
| Paradichlorbenzene | 100 | 125 |
| Petroleum oil | 100 | 100 |
| Phenol | 100 | 110 |
| Phenol | 25 | 110 |
| Phosphoric acid | 25 | B. Pt. |
| Phosphoric acid | 50 | 135 |
| Phosphoric acid | 85 | 135 |
| (S) Potassium permanganate and | 3 | R. T. |
| Sulphuric acid | 10 | R. T. |
| Rayon Solutions | | |
| $Na_2SO_4$ | 12-20 | 60 |
| $H_2SO_4$ | 8-12 | ... |
| $MgSO_4$ | 4-6 | ... |
| $ZnSO_4$ | 1 | ... |
| Sodium chloride | 25 | B. Pt. |
| (S) Sodium dichromate and | 5 | R. T. |
| Sulphuric acid | 10 | R. T. |
| (S) Sodium hydroxide | to 80 | to 135 |
| Sodium hydroxide and | 3 | 50 |
| Camphor | .08 | 50 |
| Sodium hydrosulphite | 3 | R. T. |
| Sodium hydrosulphite and | 3 | R. T. |
| Hydrochloric acid | 0.1 | R. T. |
| Sodium hydrosulphite and | 3 | R. T. |
| Sodium hydroxide | 0.1 | R. T. |
| (S) Sodium hypochlorite | 5 | R. T. |
| Sodium nitrate and | Sat'd. | 110 |
| Sodium carbonate | 5 | 110 |
| Sodium nitrate and | 25 | 110 |
| Sodium carbonate | 5 | 110 |
| Sodium sulphate and | 30 | 121 |
| Sulphuric acid | 15 | 121 |
| Stannic chloride | 15 | B. Pt. |
| Stearic acid | 100 | 135 |
| Sulphuric acid | to 75 | to 135 |
| Sulphuric acid | 96 | to 80 |
| (S) Sulphuric acid | 96 | to 150 |
| Sulphuric acid and | 96 | |
| Chlorine and | Sat'd. | 45 |
| Hydrogen chloride | Sat'd. | |
| Sulphurous acid | 7 | R. T. |
| Tartaric acid | 25 | B. Pt. |
| Tetramine C | 10 | 96 |
| Water | 100 | to 100 |
| Zinc chloride | 53 | 120 |

Note: These resistances are for Karbate No. 1 (Impervious Carbon) and Karbate No. 2 (Impervious Graphite) except for reagents marked (S) where specially treated Karbate is required.

## PHYSICAL CHARACTERISTICS OF CARBON AND GRAPHITE PRODUCTS

| | Apparent Density | Weight Lb./cu.ft. | Strength, Lb. per Sq. In | | | Elastic Modulus Lb./sq.in. Multiply by $10^5$ | Specific Resistance Ohms./In.$^3$ | K (Thermal Expansion, See Note) | Thermal Conductivity B.t.u./hr./sq.ft./°F per ft. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Tensile | Compressive | Transverse | | | | |
| **Carbon Cylinders** | | | | | | | | | |
| 8 inch dia. | 1.54 | 96.0 | 660 | 2,920 | 1,320 | 5.5 | 0.0013 | 13 | 6.0 |
| 10-14 inch. dia. inc. | 1.525 | 95.0 | 470 | 2,120 | 950 | 5.4 | 0.0013 | 12 | 6.0 |
| 17-24 inch. dia. inc. | 1.54 | 96.0 | 400 | 2,200 | 790 | 5.4 | 0.0014 | 13 | 6.0 |
| 30-40 inch. dia. inc. | 1.54 | 96.0 | 400 | 1,910 | 810 | 4.3 | 0.0026 | 12 | 6.0 |
| **Carbon Blocks** | | | | | | | | | |
| 4x4 inch to 6x6 inch inc. | 1.57 | 97.8 | 840 | 4,100 | 1,670 | 9.4 | 0.0018 | 14 | 4.0 |
| 6x6 inch to 20x20 inch inc. | 1.55 | 96.7 | 500 | 2,140 | 990 | 7.1 | 0.0016 | 15 | 4.0 |
| 15x30, 24x30 & 24 inch sq. | 1.54 | 96.0 | 400 | 1,910 | 810 | 4.3 | 0.0026 | 12 | 4.0 |
| **Carbon Tubes** | | | | | | | | | |
| ½-4 inch I. D. inc. | 1.51 | 94.2 | 885 | 10,200 | 2,700 | 21.0 | 0.0014 | 15 | 3.0 |
| 5-10 inch I. D. inc. | 1.49 | 93.0 | 980 | 8,140 | 2,550 | 17.0 | 0.0016 | 21 | 3.0 |
| **Carbon Brick** | | | | | | | | | |
| Dependent on Application | 1.56 | 96.7-97.8 | 970-1,530 | 5,340-8,320 | 1,950-3,070 | 8.9-10.3 | 0.0015-0.0016 | 13-14 | 3.0 |
| **Graphite Cylinders** | | | | | | | | | |
| To 5-½ inch dia. inc. | 1.56 | 97.3 | 760 | 3,050 | 1,750 | 8.8 | 0.00036 | 5-12 | 84.0 |
| 6-12 inch dia. inc. | 1.55 | 96.7 | 610 | 3,420 | 1,810 | 8.0 | 0.00037 | 6-12 | 79.0 |
| 14 inch dia. | 1.53 | 95.3 | 580 | 3,180 | 1,490 | 6.7 | 0.00039 | 8-12 | 79.0 |
| 16 & 18 inch dia. | 1.53 | 95.3 | 500 | 3,180 | 1,490 | 6.7 | 0.00040 | 8-12 | 70.0 |
| 20 inch dia. | 1.53 | 95.3 | 440 | 3,180 | 1,490 | 6.7 | 0.00040 | 8-12 | 70.0 |
| **Graphite Squares and Slabs** | | | | | | | | | |
| To 5 inch thick inc. | 1.56 | 97.3 | 700 | 3,050 | 1,750 | 8.8 | 0.00036 | 5-12 | 94.0 |
| 6 inch thick to 144 sq. in. | 1.55 | 96.7 | 700 | 3,420 | 1,810 | 8.0 | 0.00037 | 6-12 | 84.0 |
| Over 144 sq. in. section | 1.53 | 95.3 | 570 | 3,180 | 1,490 | 6.7 | 0.00039 | 8-12 | 79.0 |

## STRUCTURAL CARBON AND GRAPHITE (Continued)

| | Apparent Density | Weight Lb. cu.ft. | Strength Lb. per Sq. In. | | | Elastic Modulus Lb./sq. in. Multiply by $10^6$ | Specific Resistance Ohms./In.[1] | K (Thermal Expansion, See Note) | Thermal Conductivity B.t.u./hr. sq.ft./°F per ft. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Tensile | Compressive | Transverse | | | | |
| **Graphite Tubes** | | | | | | | | | |
| ½–4 inch. I. D. inc. | 1.68 | 104.7 | 780 | 4,550 | 2,820 | 14.0 | 0.0003 | 12 | 94.0 |
| 5–10 inch. I. D. inc. | 1.67 | 104.0 | 870 | 5,100 | 2,980 | 13.0 | 0.0003 | 12 | 84.0 |
| **Graphite Brick. Standard sizes** | 1.86 | 97.3 | 700 | 3,050 | 1,750 | 8.8 | 0.00036 | 5–12 | 84.0 |
| **Karbate No. 1 (Impervious Carbon)*** | | | | | | | | | |
| Tubes ½–2 inch I. D. inc. | 1.77 | 110.0 | 1,700 | 10,500 | 4,170 | 29.0 | 0.00164 | 27 | 3.0 |
| Over 2 inch I. D. | 1.76 | 110.0 | 2,000 | 10,500 | 4,640 | 26.0 | 0.0016 | 33 | 2.8 |
| **Karbate No. 2 (Impervious Graphite)*** | | | | | | | | | |
| Tubes ½–2 inch I. D. inc. | 1.86 | 116.0 | 2,600 | 8,900 | 4,650 | 23.0 | 0.00034 | 23 | 85.0 |
| Over 2 inch I. D. | 1.91 | 119.0 | 2,350 | 10,500 | 4,980 | 21.0 | 0.00033 | 24 | 75.0 |
| **Carbocell (Porous Carbon)**** | | | | | | | | | |
| Grade C (Finest) | 1.34 | 84.0 | 500 | 1,530 | 2,700 | >1.2 | 0.0020 | 6 | 3.0 |
| Grade 60 | 1.05 | 69.0 | 190 | 600 | 850 | >1.2 | 0.0070 | 27 | 1.5 |
| Grade 50 | 1.05 | 69.0 | 180 | 500 | 830 | >1.2 | 0.0070 | 27 | 1.4 |
| Grade 40 | 1.04 | 69.0 | 120 | 320 | 900 | >1.2 | 0.0057 | 27 | 1.0 |
| Grade 30 | 1.04 | 69.0 | 100 | 250 | 770 | >1.2 | 0.0070 | 27 | 1.0 |
| Grade 20 | 1.03 | 68.0 | 90 | 240 | 700 | >1.2 | 0.0070 | 27 | 1.0 |
| Grade 10 | 1.03 | 68.0 | 80 | 160 | 300 | >1.2 | 0.0080 | 27 | 1.0 |
| **Graphicell (Porous Graphite)**** | | | | | | | | | |
| Grade C (Finest) | 1.35 | 84.0 | 600 | 1,080 | 1,680 | ..... | 0.00045 | 6 | 60.0 |
| Grade 60 | 1.05 | 69.0 | 110 | 250 | 500 | ..... | 0.0012 | 21 | 50.0 |
| Grade 50 | 1.05 | 69.0 | 110 | 250 | 500 | ..... | 0.0012 | 21 | 45.0 |
| Grade 40 | 1.04 | 69.0 | 100 | 190 | 500 | ..... | 0.0013 | 21 | 45.0 |
| Grade 30 | 1.04 | 69.0 | 80 | 200 | 320 | ..... | 0.0017 | 21 | 40.0 |
| Grade 20 | 1.03 | 68.0 | 60 | 140 | 310 | ..... | 0.0020 | 21 | 30.0 |
| Grade 10 | 1.03 | 68.0 | 50 | 140 | 270 | ..... | 0.0020 | 22 | 20.0 |

Carbon and graphite products are resistant to most acids and alkalis. * See preceding table for chemical resistance. ** See following table for additional data.
NOTE: Coefficient of Thermal Expansion: To Temperature t°F = (K = 0.003 (t°F), $10^{-7}$; to Temperature t°C 9 = (1.8 K+0.007 (t°C), $10^{-7}$.

## PHYSICAL PROPERTIES OF POROUS CARBON AND POROUS GRAPHITE

| | Porosity Per Cent | Average Pore Diameter | | Filter Action Min. Diameter Particle Retained Inches | Av. Water * Permeability at 5 Lb./sq.in. Pressure Gal./sq.ft./min. | Av. Air ** Permeability at 2 inches $H_2O$ Pressure Cu.ft./sq.ft./min. |
|---|---|---|---|---|---|---|
| | | Inches | Microns | | | |
| **Carbocell** | | | | | | |
| Grade C | 36.0 | 0.0002 | 5 | ..... | 0.30 | .... |
| Grade 60 | 48 | 0.0013 | 33 | 0.00047 | 14.0 | .... |
| Grade 50 | 48 | 0.0019 | 48 | 0.00079 | 30.0 | .... |
| Grade 40 | 48 | 0.0027 | 69 | 0.00098 | 45.0 | 4.0 |
| Grade 30 | 48 | 0.0039 | 99 | 0.00173 | 80.0 | 8.5 |
| Grade 20 | 48 | 0.0055 | 140 | 0.00300 | 120.0 | 17.0 |
| Grade 10 | 48 | 0.0075 | 190 | 0.00590 | 175.0 | 33.0 |
| **Graphicell** | | | | | | |
| Grade C | 36 | 0.0002 | 5 | ..... | 0.30 | .... |
| Grade 60 | 48 | 0.0013 | 33 | 0.00047 | 14.0 | .... |
| Grade 50 | 48 | 0.0019 | 48 | 0.00079 | 30.0 | .... |
| Grade 40 | 48 | 0.0027 | 69 | 0.00098 | 45.0 | 4.0 |
| Grade 30 | 48 | 0.0039 | 99 | 0.00178 | 80.0 | 8.5 |
| Grade 20 | 48 | 0.0055 | 140 | 0.00300 | 120.0 | 17.0 |
| Grade 10 | 48 | 0.0075 | 190 | 0.00590 | 175.0 | 33.0 |

Note: Carbocell can be treated so as to be wettable for use in caustic filtration. Both are resistant to most acids and alkalis.
* Water at 70 deg. F, 1 inch thick plate. ** Air at 70 deg. F and 760 mm. Hg. pressure 15 per cent relative humidity 1 inch thick plate.

## MAKERS OF STRUCTURAL CARBON AND GRAPHITE PRODUCTS

| MANUFACTURER (Name and Address) | Products |
|---|---|
| Acheson Graphite Corp., New York, N. Y. | Graphite electrodes and various shapes |
| International Graphite & Electrode Corp., St. Mary's, Pa. | Graphite electrodes and various shapes |
| National Carbon Co., Inc., Cleveland, Ohio. | Carbon and graphite brick, tile, tower packing, tubes, pipe, special shapes, electrodes |
| Speer Carbon Co., St. Mary's, Pa. | Carbon and graphite brick, plates, blocks, tubes, cylinders, bushings, shapes |
| Stackpole Carbon Co., St. Mary's, Pa. | Various carbon and graphite products |

Note: Manufacturers of graphite crucibles are listed under "Refractories."

# RUBBER and LIKE PRODUCTS

## CHEMICAL PROPERTIES OF RUBBER-LIKE MATERIALS

*EDITOR'S NOTE: The following paragraphs describing the chemical properties of some of the synthetics have been supplied to us by the manufacturers. They are intended to give an indication of the possibilities and the limitations of these materials. However, for a particular application it is generally advisable to contact the manufacturer and have specific tests made.*

### NEOPRENE

Neoprene is a basic thermosetting (not thermoplastic) raw material which is mixed with compounding ingredients and processed into finished products by rubber manufacturers. There are several different basic types of neoprene which have widely varying properties (see table of physical properties for broad range). Neoprene is available in black, white and colors, odorless when specified.

Animal, vegetable and petroleum-base products cause slight swelling but have little effect on the physical properties. Neoprene does not dissolve, become gummy or slough off.

In general, neoprene may be used in contact with inorganic chemicals. Salts have little effect. Even strong alkalis may be successfully handled. Mineral acids cause deterioration when used in concentrations above 50 per cent. Strong oxidizing acids, such as sulphuric, nitric and chromic, should be avoided. Halogens cause embrittlement in liquid form; however, dilute gas and aqueous solutions may be handled satisfactorily.

Neoprene resists the attack of most organic compounds, the more highly saturated compounds having less effect than the less saturated. Neoprene is not recommended for use with the chlorinated hydrocarbons or with creosote. Certain aromatic solvents such as benzol also cause rapid swelling.

### THIOKOL

The manufacturers of Thiokol synthetic rubbers state that a number of different organic polysulphide polymers that vary in characteristics from soft to hard rubber are made under this name. However, unlike natural rubber, the products are practically unaffected by petroleum hydrocarbons and most commercial solvents. They are resistant to alcohol, esters and ketones. The swell of these products in aromatic hydrocarbons varies from practically no swell to around 100 per cent increase in volume, depending on the type. Even when Thiokol swells in aromatic solvents, it still retains good physical characteristics. It is not materially affected by carbon tetrachloride but is attacked by ethylene dichloride in varying degrees. Thiokol is not affected by sunlight, air, ozone or ultra-violet.

It can be compounded to give various hardnesses and characteristics suitable for each particular application. While not possessing original tensile strength as great as natural rubber, it is stated far to exceed natural rubber in both strength and abrasion resistance when in contact with gasoline and oils. Since it has extremely low permeability, there is practically no diffusion loss through Thiokol when conducting volatile solvents. In certain compositions it can be made into molding powder and liquid dispersions.

Thiokol can be used at temperatures ranging from 200 to −40 deg. F. In addition to being used as rubber, it can be used to plasticize other rubbers and similar materials where an insoluble plasticizer is desired.

### PERBUNAN

Perbunan is a synthetic rubber-like material which can be processed and vulcanized with sulphur in much the same way as natural rubber. Like the latter, it can be compounded to give varying physical properties depending on the particular application in mind. With active carbon black it can be reinforced to give compounds of high tensile strength and superior abrasion resistance. In addition, it has high elasticity and resilient energy (low hysteresis loss), and has good resistance to prolonged stress (slight creep under prolonged loading). The heat conductivity is about 20 per cent higher than that of natural rubber.

Perbunan has excellent aging properties and possesses good heat and fatigue resistance. It can be used at temperatures up to 300 deg. F., and will remain flexible at temperatures as low as −45 deg. F.

Perbunan is unaffected by water, dilute acids or alkalis, or salt solutions of any

### Solvent Resistance of Thiokol F

(Immersion tests at room temperature for one year. Percentage swell determined from increase in length of 1/4 x 1/16 x 4-in. test strips.)

| Solvent | Per Cent Swell | Condition |
|---|---|---|
| Motor gasoline | 1.0 | OK |
| 80/20 gasoline/benzol (by vol.) | 3.0 | OK |
| 50/50 gasoline/benzol (by vol.) | 6.3 | OK |
| Benzol | 25.0 | Firm |
| Kerosene | 0.8 | OK |
| SAE No. 30 motor oil | 0.5 | OK |
| No. 4 fuel oil | 3.5 | OK |
| Drip oil | 13.8 | OK |
| Linseed oil (raw) | 1.3 | Surface hardened |
| Cottonseed oil | 0.0 | OK |
| Acetone | 2.5 | OK |
| Methyl alcohol | 1.3 | Surface slightly affected |
| Carbon tetrachloride | 8.8 | OK |
| Ethylene dichloride | Destroyed | |

### Solvent Resistance of Chemigum

(Samples immersed at room temperature for 12 days)

| Solvent | Per Cent Swell | Condition |
|---|---|---|
| 80/20 gasoline/benzol | 0.80 | OK |
| Lacquer thinner | 100 | OK |
| Turpentine | 27 | OK |
| Benzol | 105 | OK |
| Kerosene (room temp.) | 0.20 | OK |
| Kerosene (212 deg. F.) | 1.50 | OK |

### Solvent Resistance of Perbunan

(Samples immersed at room temperature for 24 days.)

| Solvent | Per Cent Weight Increase | Tear Resistance |
|---|---|---|
| n-Heptane | No effect | Good |
| Varsol (heavy naphtha) | 20 | Good |
| Turpentine | 25 | Good |
| SAE 30 Motor oil | No effect | Good |
| Nujol | No effect | Good |
| Cottonseed oil | No effect | Good |
| Acetone | 97 | Very poor |
| Benzene | 214 | Very poor |
| Carbon disulphide | 97 | Poor |
| Amyl acetate | 53 | Poor |
| Methyl alcohol | No effect | Good |
| Diethyl ether | 23 | Good |
| Carbon tetrachloride | 160 | Very poor |
| Ethylene dichloride | 387 | Very poor |
| Aniline | 280 | Very poor |
| Glacial acetic acid | No effect | Good |

### Solvent Resistance of Extruded Resistoflex PVA

(Samples immersed at room temperature for 240 hours.)

| Solvent | Specific Gravity at 72° F. | Per Cent Shrinkage or Expansion in 6 in. | Tensile Strength, Lb./sq. in. | Per Cent Elongation in 2 in. | Hardness (Durometer) |
|---|---|---|---|---|---|
| Before immersion | 1.259 | ..... | 5,236 | 213 | 85 |
| 66% Gasoline, 24% ethanol, 10% benzene, by volume | 1.195 | −1.0 | 5,057 | 180 | 86 |
| Gasoline (leaded) | 1.260 | −0.30 | 5,255 | 220 | 85 |
| Kerosene | 1.255 | +0.30 | 5,247 | 220 | 84 |
| Benzol | 1.251 | +0.30 | 5,290 | 225 | 84 |
| Xylol | 1.260 | +0.20 | 5,351 | 220 | 84 |
| Acetylene gas | 1.256 | +0.10 | 5,340 | 220 | 85 |
| Methylene dichloride | 1.261 | −0.40 | 5,110 | 225 | 84 |
| Trichlorethylene | 1.253 | +0.10 | 5,140 | 225 | 86 |
| Carbon tetrachloride | 1.259 | 0.00 | 5,084 | 145 | 84 |
| Monochlorbenzol | 1.258 | +0.10 | 5,026 | 190 | 84 |
| Methanol (anhydrous) | 1.203 | −6.50 | 5,980 | 195 | 86 |
| Ethanol (anhydrous) | 1.181 | −4.30 | 5,779 | 190 | 87 |
| Ethylene glycol | 1.186 | +4.70 | 4,335 | 185 | 77 |
| Acetone | 1.246 | −1.20 | 5,203 | 175 | 87 |
| Petrohol | 1.224 | −1.30 | 5,971 | 165 | 89 |
| Furfural | 1.250 | −2.00 | 5,890 | 175 | 88 |
| Methyl acetate | 1.269 | −0.70 | 5,403 | 185 | 85 |
| Ethyl acetoacetate | 1.258 | −0.50 | 5,491 | 205 | 85 |
| Diethyl ether | 1.260 | −0.30 | 4,980 | 230 | 86 |
| Dioxane | 1.271 | −1.30 | 5,272 | 195 | 85 |
| Freon gas | 1.270 | −0.50 | 5,636 | 205 | 86 |
| Butane gas | 1.268 | +0.30 | 5,352 | 200 | 86 |
| Propane gas | 1.267 | +0.20 | 5,529 | 200 | 87 |
| Sulphur dioxide | 1.269 | +0.50 | 5,497 | 215 | 86 |
| Aniline | 1.256 | −0.70 | 5,557 | 185 | 86 |
| Formamide | 1.201 | −4.00 | 3,845 | 195 | 77 |

## RUBBER and LIKE PRODUCTS (Continued)

concentration. It swells very slightly in aliphatic hydrocarbons, vegetable and animal oils and fats. The reduction in physical properties as a result of swelling is small, making Perbunan especially suitable for gasoline and oil-resistant applications. In aromatic hydrocarbons, Perbunan swells to an extent comparable to natural rubber, but it is superior to natural rubber for gasoline-benzol mixtures. Chlorinated hydrocarbons and organic bases have a strong swelling action on Perbunan. Ketones, organic acids, alcohols and esters have a greater swelling effect than on natural rubber.

It should be pointed out that the behavior of Perbunan in most practical applications depends upon proper compounding and processing, and definite conclusions should only be drawn from actual service tests.

### PHYSICAL PROPERTIES OF RUBBER AND RUBBER-LIKE MATERIALS

| PROPERTY | Ameripol, Oil-resisting, Soft | Ameripol, Tire Type, Soft | Ameripol Hard | Chemigum Tire Cpd. | Koroseal | | Neoprene (all forms) | Perbunan | Pliolite No. 40 | Resistoflex Molded & Ext. | Natural Rubber | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Hard | Soft | | | | | Hard | Soft |
| Specific gravity | 0.99–1.6 | 0.96–1.20 | 1.1–1.3 | 1.19 | 1.3–1.4 | 1.2–1.3 | 1.27–1.30 | 0.96 | 1.06 | 1.26 | 1.17–1.18 | 0.93–1.17 |
| Tensile strength, lb. per sq. in. | 1,000–4,500 | 1,000–4,000 | 4,000–10,000 | 4,000 | 2,000–9,000 | 500–2,500 | 1,000–4,000 | 500–5,000 | 4,000–5,000 | 2,000–5,000 | 4,000–11,000 | 1,000–6,000 |
| Hardness, Shore durometer | 15–90 | 50–80 | 80–100 | 65 | 80–100 | 30–80 | 15–95 | 30–90 | ..... | ..... | 70–100 | 30–80 |
| Maximum temperature for use, °F. | 260–300 | 240–280 | 260–300 | 450+ | 212 | 190 | 300 | 300 | 160–248 | 250 | 220 | 150–180 |
| Dielectric strength, volts per mm. | ..... | ..... | ..... | ..... | 30,000–50,000 | 15,000–30,000 | ..... | ..... | ..... | 6,000–10,000 | 40,000–150,000 | 40,000–55,000 |
| Effect of heat | Stiffens slightly | | ..... | Stiffens | Softens | Softens | Stiffens slightly | Stiffens | Softens | Softens | Softens | Softens & Det. |
| Abrasion resistance | Excellent | | Good | Excellent | Good | Good | Equal to rubber | Excellent | ..... | Good | Good | Excellent |
| Effect of sunlight | Discolors, cracks less than rubber | | ..... | Deteriorates | None | None | None | Slight | None | None | Discolors | Deteriorates |
| Effect of aging | Highly resistant, stiffens slightly | | None | None | None | None | Better than rubber | Highly resistant | None | None | None | Highly resistant |
| Machining qualities | Can be ground | | Excellent | Excellent | Good | Can be ground | Can be ground | Can be ground | ..... | ..... | Excellent | Can be ground |

### REPRESENTATIVE MAKERS OF INDUSTRIAL RUBBER PRODUCTS AND RUBBER-LIKE MATERIALS

| MANUFACTURER (Name and Address) | Products |
|---|---|
| American Hard Rubber Co., New York, N. Y. | Hard and soft rubber, neoprene and Thiokol linings, pipe, fittings, shapes, pails, pumps, rubber paint, etc. |
| Atlas Mineral Products Co. of Pa., Merzetown, Pa. | Rewbon seamless rubber linings and Zerok synthetic resin linings |
| Boston Woven Hose & Rubber Co., Boston, Mass. | Conveyor and transmission belts, hose, mechanical rubber goods |
| Crane Packing Co., Chicago, Ill. | Rubber and synthetic rubber packings |
| Custodis Construction Co., New York, N. Y. | Custoplast soft rubber and neoprene tank linings |
| Dayton Rubber Mfg. Co., Dayton, Ohio | Oilproof rubber belts, transmission belting, synthetic rubber products |
| E. I. du Pont de Nemours & Co., Neoprene Div., Wilmington, Del. | Neoprene polymerized chloroprene rubber |
| Firestone Tire & Rubber Co., Akron, Ohio | Perbunan synthetic rubber |
| Garlock Packing Co., Palmyra, N. Y. | Rubber packings, transmission belting, molded goods |
| Gates Rubber Co., Denver, Colo. | Transmission and conveyor belting |
| L. H. Gilmer Co., Tacony, Philadelphia, Pa. | Transmission belting |
| B. F. Goodrich Co., Akron, Ohio | Acid- and abrasion-resistant linings, hose, conveyor and transmission belting, packings, hard-rubber pipe and molded goods, rubber paints, Koroseal plastic, Anode process, Ameripol tires and mechanical goods |
| Goodyear Tire & Rubber Co., Akron, Ohio | Hose, conveyor and transmission belting, packings, linings, mechanical rubber goods, Pliolite modified rubber plastic, Chemigum |
| Hewitt Rubber Corp., Buffalo, N. Y. | Hose, transmission and conveyor belting, packings |
| Hydrocarbon Chemical & Rubber Co., Akron, Ohio | Synthetic rubbers (Ameripol) |
| Jenkins Bros. Rubber Div., Bridgeport, Conn. | Mechanical rubber goods, packings, molded and extruded shapes |
| The Osborn Mfg. Co., Johns Conveyor Div., Cleveland, Ohio | Johns rubber and synthetic rubber "moving pipe-line" conveyors |
| Maurice A. Knight, Akron, Ohio | Rubber and neoprene-lined rubber drums, Pyroflex resin-base tank linings |
| Linear Packing & Rubber Co., Philadelphia, Pa. | Rubber and synthetic rubber packings |
| Luzerne Rubber Co., Trenton, N. J. | Hard rubber pipe, fittings, valves, shapes, tanks, rayon apparatus and other equipment |
| Manhattan Rubber Mfg. Div., Passaic, N. J. | Transmission and conveyor belting, blocks, hose, piping, rolls, brake lining, bearings |
| Miller Rubber Co., Akron, Ohio | Hose, molded products, linings and coverings |
| Paramount Rubber Service, Inc., Detroit, Mich. | Seamless rubber linings, rubber paint, molds, coatings and insulations |
| Resistoflex Corp., Belleville, N. J. | Rubber-like oil-resisting resin — tubing, hose, sheets, molded shapes, gloves |
| Self-Vulcanising Rubber Co., Chicago, Ill. | Liquid and plastic rubber self-vulcanizing coatings and lining materials |
| Standard Oil Development Co., Elizabeth, N.J. | Perbunan synthetic rubber |
| Jos. Stokes Rubber Co., Trenton, N. J. | Molded hard rubber products of all kinds |
| Thermoid Rubber Co., Trenton, N. J. | Hose, belting, packing, mechanical rubber goods |
| Thiokol Corp., Trenton, N. J. | Thiokol olefine polysulphide synthetic rubber — crude sheet, molding powder and liquid dispersions |
| U. S. Rubber Co., New York, N. Y. | Rubber-lined pipe, hard, semi-hard and soft linings, abrasion-resistant linings, hard rubber pipe, acid hose, packings, mechanical rubber goods and belting |
| U. S. Stoneware Co., Akron, Ohio | Resilon and Tygon polymer tank linings, rubber latex linings |
| Vulcanized Rubber Co., New York, N. Y. | Hard and semi-hard rubber molded products |

# WOOD FOR CHEMICAL EQUIPMENT

## PHYSICAL PROPERTIES OF WOODS COMMONLY USED FOR EQUIPMENT AND PLANT STRUCTURES

| | Cypress | Douglas Fir (Coast.) | L. L. Y. Pine | Redwood | Sugar Maple | White Oak |
|---|---|---|---|---|---|---|
| Lb. per cu. ft. (12% moisture) | 32 | 34 | 41 | 28 | 44 | 47 |
| Tensile str.,* lb. per sq. in. (12% moisture) | 7,200 | 8,100 | 9,300 | 6,900 | 9,500 | 7,900 |
| Compressive str.,* lb. per sq. in. (12% moisture) | 4,740 | 6,450 | 6,150 | 4,560 | 5,390 | 4,350 |
| Thermal cond., B.t.u. per sq. ft., hr., °F., in. | 0.83 | 0.77 | 0.96 | 0.76 | 1.16 | 1.22 |
| Hardness | Med. | Med. | Hard | Mod. hard | Med. | Hard |

*At proportional limit, in static bending, and compression parallel to grain, respectively.

## CONDITION OF WOODS AFTER 31 DAYS' IMMERSION IN COLD SOLUTIONS*

(Examined after 7 days drying)

| | Fir | Oak | Oregon Pine | Yellow Pine | Spruce | Redwood | Maple | Cypress |
|---|---|---|---|---|---|---|---|---|
| Hydrochloric Acid, 5% | NAC | NAC | NAC | SS | SS | SS | NAC | NAC |
| Hydrochloric Acid, 10% | NAC | NAC | NAC | SS | SS | SS | NAC | NAC |
| Hydrochloric Acid, 50% | SS,SB,SWF | SS,WF | S,WF | S,WF | S,WF | S,WF | S,WF | S,WF |
| Sulphuric Acid, 1% | NAC | NAC | NAC | SS | SS | NAC | NAC | SS,SB |
| Sulphuric Acid, 5% | SS | SS | SS | SS | SS,SB | SS,SB | NAC | SS,SB |
| Sulphuric Acid, 10% | S,FSD | S,FSD | S,FSD | S,FSD | S,FSD | S,FSD | S,FSD | S,FSD |
| Sulphuric Acid, 25% | SSp,FSD | SSp,FSD | SSp,FSD | SSp,FSD | SSp,FSD | SSp,FSD | SSp,FSD | SSp,FSD |
| Caustic Soda, 5% | S,NAC | MSh,SWp | SS | SS,FSD | SSp,FSD | SSp,FSD | MSh | SSp,FSD |
| Caustic Soda, 10% | S,FSD | MSh,WF,Horny | SS | SS,SB,FSD | SS,SB,FSD | SS,SB,FSD | MSh | S,SB,FSD |
| Alum, 13% | NAC | NAC | NAC | NAC | NAC | NAC | NAC | NAC |
| Sodium Carbonate, 10% | SB,GC | NAC | GC | SB,GC | SB,GC | SB,GC | GC | SB,GC |
| Calcium Chloride, 25% | NAC | NAC | NAC | NAC | NAC | NAC | NAC | NAC |
| Common Salt, 25% | NAC | NAC | NAC | SS,GC | SS,GC | SB,GC | NAC | NAC |
| Water | NAC | NAC | NAC | NAC | NAC | NAC | NAC | NAC |
| Sodium Sulphide | SS,SB | MSh,WF | SB | SB | SB | SB | MSh,FSD | FSD |

## CONDITION OF WOODS AFTER 8 HOURS BOILING IN SOLUTIONS*

(Examined after 7 days drying)

| | Fir | Oak | Oregon Pine | Yellow Pine | Spruce | Redwood | Maple | Cypress |
|---|---|---|---|---|---|---|---|---|
| Hydrochloric Acid, 10% | SB,S | FSD | FSD | FSD | FSD | FSD | FSD | FSD |
| Hydrochloric Acid, 50% | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG | FD,Ch,B,S,NG |
| Sulphuric Acid, 4% | SB,GC | SB,GC | SB,GC | SB,GC | SB,GC | SB,GC | SB,GC | SB,GC |
| Sulphuric Acid, 5% | SS,GC | SB,GC | SB,GC | SB,GC | SB,FSD | SB,GC | SB,GC | SB,FSD |
| Sulphuric Acid, 10% | SS,GC | BFD,Wpd,NG | Sp,FD,NG | B,Sp,FD,NG | B,Sp,FD,NG | SB,FSD | SB,FSD | B,FD |
| Caustic Soda, 5% | SS | MSh | S | GC | S,GC | S,GC | Sh | SSp |
| Alum, 13% | SB,GC | NAC | NAC | SB,GC | SB,GC | SB,GC | NAC | SB,GC |
| Sodium Carbonate, 10% | SB,GC | GC | GC | GC | GC | GC | GC | SB,GC |
| Calcium Chloride, 25% | SB,GC | SB,SS,GC | NAC | SB,GC | SB,GC | NAC | NAC | SB,GC |
| Common Salt, 25% | NAC | NAC | NAC | SB,GC | NAC | SB,GC | NAC | NAC |
| Water | NAC | NAC | NAC | SB,GC | NAC | NAC | NAC | NAC |

* The two tables describing the condition of eight varieties of woods used for tanks and other chemical-resistant uses are based on a report of James K. Stewart, consulting chemist, to the Mountain Copper Co., Martinez, Calif. Tests were conducted on samples 1 x 4 x ¼ in. in size, seasoned and chosen so as to be as nearly as possible in the same physical condition as the woods would be when used for equipment construction. Results of the tests are described by terms explained in the following key:

**Abbreviation Key**

B — Brittle
Ch — Charred
FD — Fiber Disintegrated
FSD — Fiber Slightly Disintegrated
GC — Good Condition
MSh — Much Shrunk
NAC — No Apparent Change
NG — No Good
S — Softer
SB — Slightly Brittle
Sh — Shrunk
Sp — Spongy
SS — Slightly Softer
SSp — Slightly Spongy
SWF — Slightly Weakened Fiber
SWp — Slightly Warped
WF — Weakened Fiber
Wpd — Warped

## Representative Makers of Wood Tanks and Pipe for Chemical Applications

Acme Tank Co., New York, N. Y.
Alert Pipe & Supply Co., Bay City, Mich.
Atlantic Tank Corp., North Bergen, N. J.
Axtell Co., Fort Worth, Texas
Baltimore Cooperage Tank & Tower Co., Baltimore, Md.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
C. F. Braun & Co., Alhambra, Calif.
W. E. Caldwell Co., Louisville, Ky.
Challenge Co., Batavia, Ill.
Caspar Lumber Co., Hobart Bldg., San Francisco, Calif.
A. J. Corcoran, Inc., Jersey City, N. J.
Cypress Tank Co., Shreveport, La
Dempster Mill Mfg. Co., Beatrice Neb.
Drane Tank Co., Fort Worth, Texas
Drummond Mfg. Co., Louisville, Ky.
Dunek Tank Works, Inc., Milwaukee, Wis.
G. Elias & Bro., Buffalo, N. Y.
Engle Tank Co., Chicago, Ill.
Federal Pipe & Tank Co., Seattle
Fleming Tank Co., Pittsburgh, Pa.
Fluor Corp., Ltd., Los Angeles
Fibre Conduit Co., Orangeburg, N. Y.
Foster Wheeler Corp., New York
General Tank Corp., Kearny, N. J.
Amos H. Hall & Sons, Philadelphia
Harry Cooling & Equipment Co., Doylestown, Pa.
Hauser-Stander Tank Co., Cincinnati, Ohio
Hammond & Little River Redwood Co., Samoa, Calif.
Henderson Bros Co., Waterbury
R. R. Howell & Co., Minneapolis
James Hunter Machine Co., North Adams, Mass
Johnson & Carlson, Chicago, Ill.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
Lincoln Tank Co., Shreveport, La.
Lille-Hoffman Cooling Towers, Inc., St. Louis, Mo.
Marley Co., Kansas City, Kan.
Michigan Pipe Co., Bay City, Mich.
National Tank Co., Tulsa, Okla.
National Tank & Pipe Co., Portland, Oregon
New England Tank & Tower Co., Everett, Mass.
Pacific Cooperage Co., Portland, Oregon
Pacific Wood Tank Corp., San Francisco, Calif.
Pacific Tank & Pipe Co., Oakland, Calif.
Parkersburg Rig & Reel Co., Parkersburg, West Va.
Fred C. Pfeil, Inc., Buffalo, N. Y.
J. F. Pritchard & Co., Kansas City, Mo.
Redwood Mfrs. Co., San Francisco, Calif.
Wm. B. Scaife & Sons Co., Pittsburgh Dist., Oakmont, Pa.
Schubert-Christy Corp., St. Louis
A. T. Stearns Lumber Co., Boston
Treadwell Construction Co., Station A., Midland, Pa.
Union Lumber Co., Crocker Bldg., San Francisco, Calif.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wendnagel Co., Chicago, Ill.
C. H. Wheeler Mfg. Co., North Phila., Pa.
G. Woolford Wood Tank Co., Darby, Pa.
A. Wyckoff & Son Co., Elmira, N. Y.

# Western Opportunities for Chemical Engineers

**PAUL D. V. MANNING**
*Editorial Representative, Chemical & Metallurgical Engineering**

A FRIEND OF MINE said, quite wisely I think, that an "industrial opportunity is a state of mind." He was referring to the business man looking for new fields of industry. His statement applies equally well to engineers and educators.

What sort of a state of mind constitutes an industrial opportunity for a chemical engineer in the 11 Western States that make up the so-called Pacific Slope? First, he must have decided that this section of the country, as a locale for his work, is the factor of primary importance and he must be prepared to accept some of the disadvantages which are found in a relatively new country. Second, he must understand that the basic sources of opportunities on the Pacific Slope are inextricably bound up with the utilization and processing of (1) electric power, (2) mineral raw materials, (3) agricultural products, (4) forest products and (5) with engineering services to other industries.

*Electric Power* — The Federal Power Commission in 1938 selected as the most important power uses in electrochemical and electro-metallurgical industries, the production of aluminum, copper, electrolytic zinc, magnesium, cadmium and minor metals, such as sodium, beryllium, calcium and lithium. Included also as prominent were the production of electrolytic chlorine and caustic soda, iron, steel and alloys, calcium carbide, carbon and graphite, and chemical nitrogen and inorganic fertilizers. Not all of these, of course, are apt to become really good opportunities on the Pacific Slope.

Of the non-ferrous metals, aluminum and magnesium probably have the greatest possibilities. A large plant for the production of aluminum is now under construction near Vancouver, Wash. Its contract for power calls for a total of 67,000 kw. Two plants near San Francisco are making magnesium compounds by precipitation of magnesium hydroxide direct from sea water and seawater bitterns by the use of lime. One of these plants is producing dead-burned magnesite from the precipitate cheaply enough to compete with the like product made from magnesite being mined in the State of Washington. No really satisfactory process for the production of magnesium from the oxide is as yet in commercial use in the United States. There is an opportunity for such a process.

**Chemical Process Industries in the Eleven Western States**

| States | No. of Plants | Percentage of Total | Value of Products (000- Omitted) | Percentage of Total Value |
|---|---|---|---|---|
| Arizona | 25 | 0.11 | $4,563 | 0.05 |
| California | 926 | 6.66 | 689,722 | 7.58 |
| Colorado | 109 | 0.79 | 5,542 | 0.06 |
| Idaho | 17 | 0.12 | 1,938 | 0.02 |
| Montana | 35 | 0.25 | 12,221 | 0.13 |
| Nevada | 5 | 0.04 | ..... | .... |
| New Mexico | 18 | 0.13 | 5,134 | 0.06 |
| Oregon | 88 | 0.64 | 29,793 | 0.33 |
| Utah | 37 | 0.27 | 1,481 | 0.02 |
| Washington | 167 | 1.20 | 107,268 | 1.17 |
| Wyoming | 36 | 0.03 | 29,993 | 0.33 |
| Total for 11 States | 1,463 | 10.24 | 887,655 | 9.75 |
| Total for United States | 13,895 | 100.00 | $10,624,506 | 100.00 |

Data from Census of Manufactures for 1937.

Electric power in the Northwest is available at $17.50 per kw.yr. (2 mills per kw.hr. at 100 per cent load factor) on the Bonneville transmission line, or at $14.50 per kw.yr. (1.65 mills per kw.hr. at 100 per cent load factor) if consumed within 15 miles of Bonneville. It will be noted that these low rates apply to power at 100 per cent load factor. Bonneville power is not especially cheap when the load factor is under 85 per cent.

*Minerals*—The 11 Western States, because of their mountain and desert regions, are highly and diversely mineralized. (See tabulation of resources, *Chem.&Met.*, Sept. 1938, p. 458.) Between them is an abundance of petroleum and natural gas. The utilization of these hydrocarbons for various organic chemical compounds has become one of the large industries.

*Agricultural Products* — Agriculture is more broadly diversified in the Pacific Western area than anywhere in the United States. Production per acre moreover is heavy. New areas are being opened up by irrigation and flood control made possible by the large new dams completed and being built. This brings to the fore opportunities for the chemical engineer in processing food products and agricultural wastes and the development of new concentrating and drying processes. More than ever now, agricultural products can be looked upon as raw materials for industry. That the government has recognized this opportunity for such development is shown by the location of one of the Department of Agriculture's regional research laboratories at Albany, Calif., to serve the 11 Western States.

*Forest Products*—There is probably no example of greater waste than in the manufacture of lumber from timber. Less than one-third of the raw material is utilized. At the same time, the finished product, lumber, is not entirely satisfactory. There is further waste in its use. It shrinks and swells, is not uniform in texture or appearance, and is not fire-resistant. Plastics have been proposed for many of the purposes for which lumber is used. But they are too expensive. There appear to be opportunities in combining the good qualities of both of these substances into a new product which would be a more satisfactory building material. Weatherproof plywood is a start in that direction.

These are a few of many projects awaiting development. If you believe, with my friend, that "opportunity is really a state of mind," it follows that the consummation of any opportunity depends primarily on men. Any chemical engineer, therefore, who has been trained to use his imagination and to think, as well as work, need have no difficulty in finding interesting opportunities in our 11 Western States.

* Extracts from a paper presented at the Berkeley, Calif., meeting of the Society for the Promotion of Engineering Education, June, 1940. Dr. Manning is also Vice-President, Western Condensing Co., and Director of Research, Golden State Co., Ltd., both of San Francisco, Calif.

# Chemical Engineering Advances

New soybean solvent extraction plant of Archer-Daniels-Midland Co., at Decatur, Ill.

GORDON W. McBRIDE *Chemical Engineer, Washington, D. C.*

*Chem. & Met.* INTERPRETATION

**Products of the lowly soybean are of interest to chemical engineers for two reasons: (1) they serve as raw materials for many chemical process industries, and (2) their manufacture entails more and more chemical technology. With increased production and dwindling exports the soybean industry may bid for an even larger share of the vegetable oil business this year. Good chemical engineering, as shown by this economic and technologic review, has placed the industry in a favorable position.**—*Editors.*

CHEMICAL ENGINEERS are well aware that soybeans and their derivatives serve as raw material for many chemical process industries. This cooperation between agriculture and industry is prospering, too. The domestic supply of soybeans has increased nearly ten fold in the past decade. (See chart *Chem. & Met.*, February, 1940, p. 88.) It has reached such proportions that of the vegetable oils only cottonseed oil exceeded soybean oil production in 1939. Moreover, soybeans are raised primarily for the oil content, whereas cottonseed oil is a by-product of the cotton industry. Further, and more important, soybeans are on their own; they are not being subsidized (except by tariff) in any agricultural program. The attainment of this large production is based on real demand and the economics of soybean production are sound. With varieties of soybeans being adapted to all climates, including the Southern strongholds of cotton, it is conceivable that the day may come when soybean oil production will lead that of all other domestic vegetable oils.

The growth of soybean crops and soybean processing is developing many problems as well as a few important achievements. Initially this crop came to market merely an oil-seed supply from the farm. Now it is the basis of a multi-product business which is producing inter-industry commodity movements which are of substantial importance to several otherwise unrelated divisions of chemical enterprise. This situation demands that a great many engineers and executives review the present status and trend of this agro-chemical activity.

The 1940 acreage planted in soybeans was 14 per cent greater than 1939. Many export markets for beans have been cut off this year because of the war. Hence the re-

# in Soybean Processing

sulting domestic oil production may be relatively greater than the 14 per cent increase in acreage implies. For the present, the plentiful supply of soybeans is contributing to continued low prices through the entire fats and oils structure. This suggests important future stability, which is desirable both for the industries using soybeans, and for the consuming public which will profit from that wider distribution insured by low prices.

Although a considerable acreage of soybeans is devoted to growing seed and other farm uses, such as green manure, pasture, and feeds, this phase of the soybean story has little interest for the chemical engineer. However, more than passing mention should be made of the food processing of soybeans, as chemical engineers are responsible for the control of many of these food plants. In addition to the growing quantities of soybeans which are brought to the market as a fresh green vegetable, large quantities of the green beans are being canned. The drying of soybeans is also of outstanding importance to the food-plant chemical engineers in the preparation of such products as soups, breakfast foods, boiled and baked beans, soy sauce, coffee substitute, and vegetable milk. Besides the fresh soy milk, condensed and dried milks are also made.

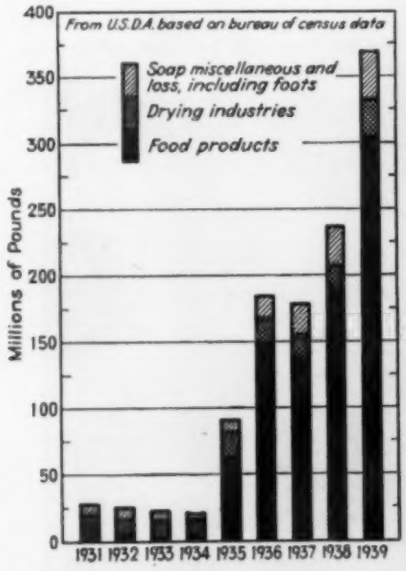
Winning of soybean oil from the beans constitutes the greatest field of technical activity, particularly in solvent extraction processes. Although the solvent method was responsible for only about one-fifth of the total 1939 soybean oil production, this method is becoming increasingly popular. Continuous screw or expeller pressing accounted for three-quarters of the yield of oil, and batch hydraulic pressing accounted for the remaining quarter.

In preparing the beans for crushing or extracting and in handling the oil and meal afterwards, the chemical engineer finds many familiar unit operations and unit processes. First the incoming beans must be conveyed, cleaned, weighed, and dried to less than 13 per cent water before storage. Beans with higher moisture content do not keep well in storage. When the beans are to be pressed they are given a preliminary cracking on coarse roller mills. This is followed by drying to 3 or 4 per cent water, and final heating to make the beans ready for the press. If it is an old-style hydraulic press, the beans are charged in batches. The modern type of press is continuous with the heated beans being fed into one end and the crude oil and press cake discharging continuously from the other end.

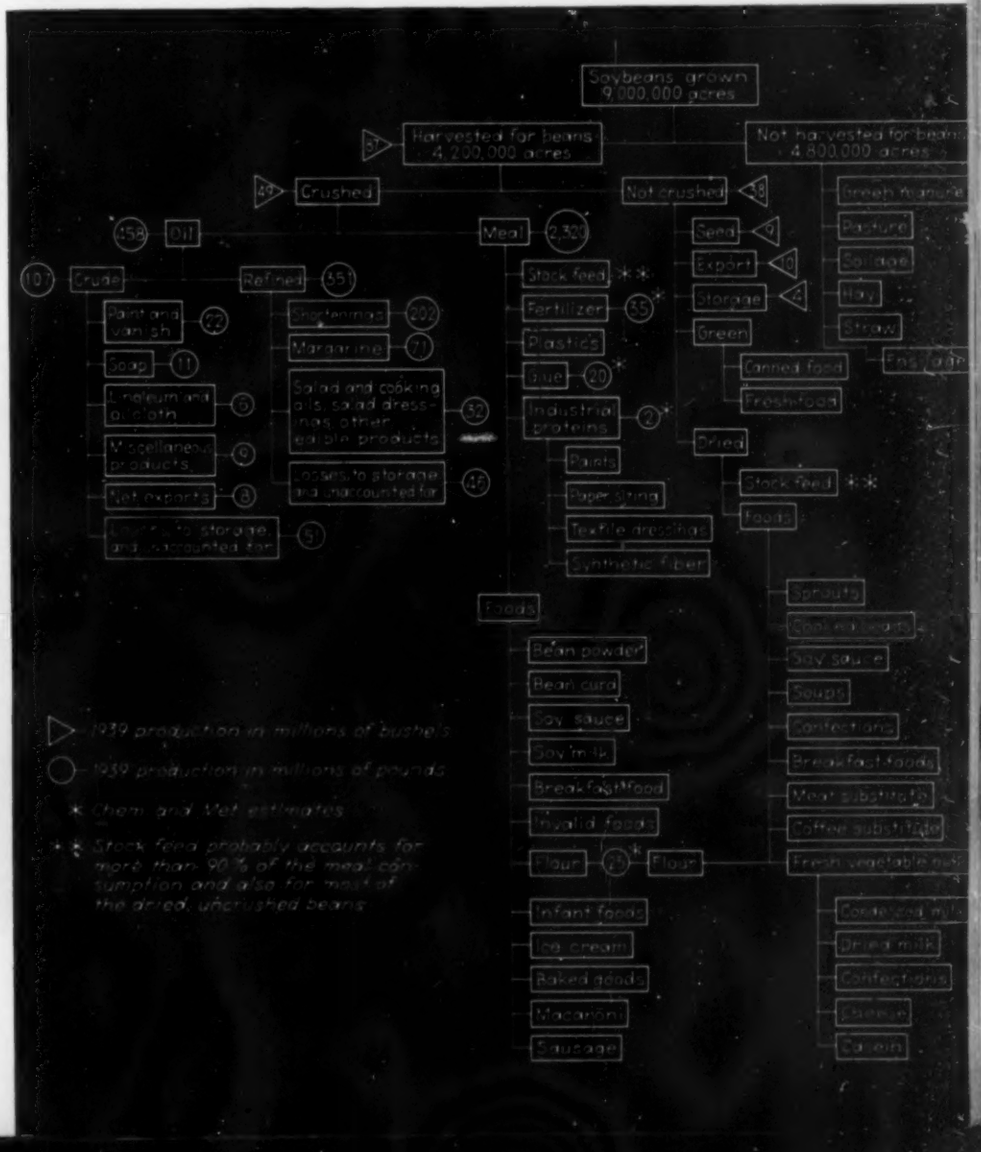
Beans which are for solvent extrac-

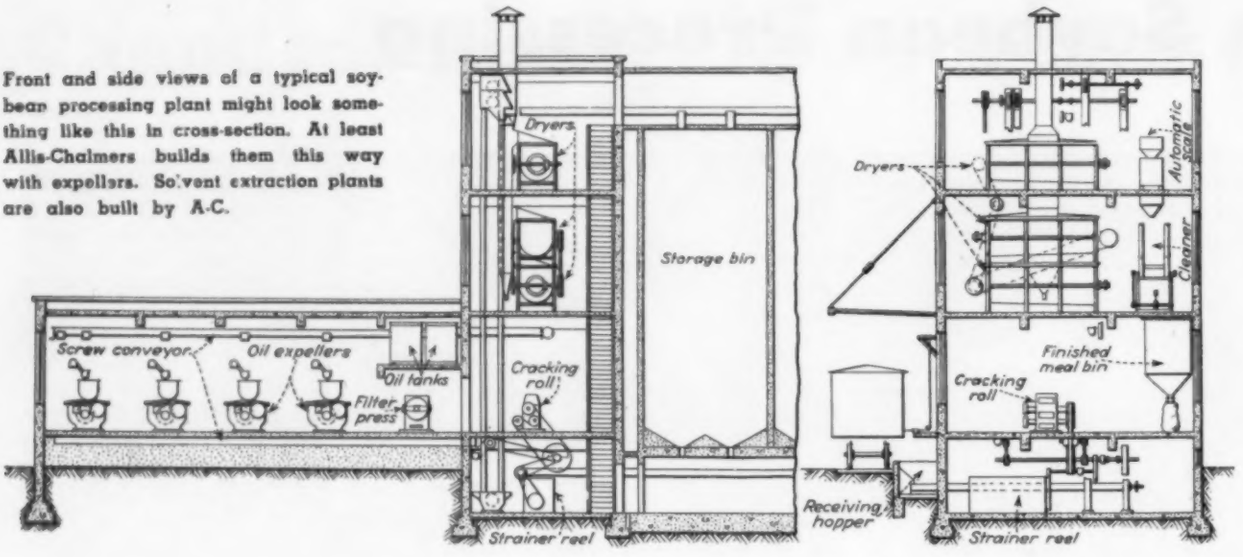
**Right—Chart showing the family of soybean derivatives, their production**

NOTE—Before 1935 soybean oil was used principally in paints and varnishes in the United States. Although the quantity used in this field has increased somewhat with the sharp increase in domestic production that has since occured, soybean oil in recent years has been used largely in food products. In 1939, food uses accounted for more than 89 per cent of the total factory consumption, drying uses for less than 10 per cent.




**Factory consumption of soybean oil by classes of products, U. S., 1931-1939**






**Front and side views of a typical soybean processing plant might look something like this in cross-section. At least Allis-Chalmers builds them this way with expellers. Solvent extraction plants are also built by A-C.**

tion are, after cracking and moderate heating, rolled into flakes to give the largest practical amount of surface for solvent contact. Moisture content of the beans is usually about 10 or 12 per cent for best results by this process. The design of the solvent extraction chamber varies considerably, but it is usually operated in a counter-current continuous flow, with the fresh solvent in contact with the extracted flakes. Hexane is the solvent used at most extraction plants. It is recovered by stripping from the extracted soybean oil and flakes and is recirculated with slight loss, the crude oil going on for cleaning or refining. Anhydrous ethyl alcohol has been considered as a possible solvent, but so far plant installations have been limited to the Orient. Halogenated hydrocarbons are also being considered in this country.

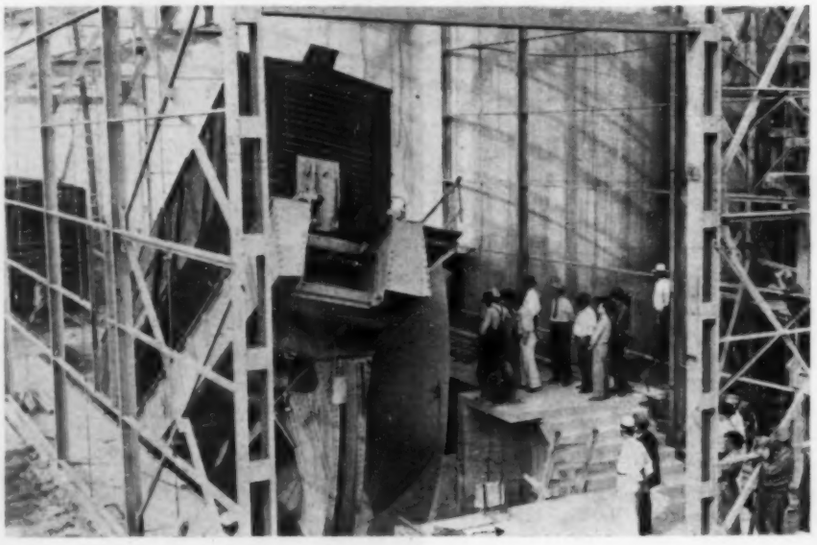
Crude soybean oil, particularly when produced by solvent extraction, contains appreciable amounts of phosphatides. It is the practice of many mills to remove these by a water washing process before refining. The phosphatides are sometimes purified and sold as soybean lecithin and sometimes returned to the soybean meal.

Refining of the crude oil for edible uses has been one of the major chemical engineering problems of the soybean industry. The traditional batch treatment with alkali was tried and found wanting; and the large kettles of the typical old-type refinery have been superseded by small continuous proportioners, mixers, and centrifuges with relatively large capacity. The resulting refined oil is washed to remove any last traces of soap or alkali. It is then ready for bleaching, hydrogenating, deordorizing, winterizing, and other typical edible oil operations. The final product is an oil of good keeping-quality, ready for whatever use may be destined.

Methods of fluids handling and storage, the coordinating of the successive continuous process operations, corrosion prevention problems occasioned by the handling of alkalis and fatty acids, and the safety problems incident to the use of flammable solvents are problems of principal concern to chemical engineers at these oil producing mills. In more detail, the list of chemical engineering unit operations which are intensively applied in soybean oil extraction plants includes size reduction, extraction, distillation, drying, gas absorption and adsorption, heat transfer, filtration, settling, and numerous other mechanical separations.

Initially chemical engineers tried to adapt standard equipment and methods of oil-seed crushing and oil handling to the soybean industry. However, cottonseed and linseed equipment required radical modifications, and in a number of cases entirely new methods or machinery were developed. These have not only proven advantageous for soybean processing, but also have been carried back to the older divisions of the oil-seed business where they are making for superior results on cot-

**Car unloader at the new ADM plant dumps the soybeans into a hopper which feeds them into the preparation process**



tonseed oil, linseed oil, and others. Perhaps this sort of development originating with soybean processing has done more to modernize the whole vegetable oil business than all other factors combined during recent years.

### CONTINUOUS DEODORIZING

One recent improvement in preparation of food oils well illustrates the advantage of modern chemical engineering practice. Typically the deodorizing of vegetable oils is a batch process carried out slowly by direct steaming of the oil in large tanks, usually with the aid of vacuum. Much more precise results may now be obtained in continuous direct-steam deodorizing equipment. This resembles a distillation column into which the oil flows at the top and works downward through the bubble-cap plates, meeting the steam which passes upward. The entire column operates under high vacuum. When such a column has been stabilized in operation, it functions continuously and there results a uniform product with a minimum of control and at relatively low cost for the high refining capacity achieved. The advantage of short-time, low-temperature contact between oil and steam in producing a stable oil is very great, both as to quality of oil and economy of operation.

Many new uses of soybean oil are being considered. The 1939 statistics show the principal industries which account for soybean oil consumption. Of the 370,000,000 lb. total classified factory consumption, 305,000,000 lb. (or 82 per cent) went into edible products. Two-thirds of this was used in manufactured shortenings, one-quarter in margarine, and the balance miscellaneous. Chemical engineers have been chiefly responsible for the development of bleaching, deodorizing, chilling, and packaging methods and equipment for all the leading plants where such shortenings are manufactured. The same is true of the manufacture of margarine and most other edible products.

The use in paints and varnishes accounted for only 6 per cent of the 1939 factory consumption of soybean oil, but the percentage increase over 1938 was nearly 45 per cent. One hundred per cent soybean oil varnishes have been made, and up to 20 per cent soybean oil can be mixed with linseed oil without depreciating the quality of linseed oil paints. The splitting of soybean oil into its fatty acids, followed by fractionation of the saturated and the unsaturated components and reesterifying with glycerine, has already provided the drying-oil industries with new raw materials.

### LIQUID-LIQUID EXTRACTION

A development of recent months may occasion a significant further increase in the amount of soybean oil used in the paint and varnish industries in the next few years. This may also come from use of the drying-oil components rather than the oil as a whole. A method of liquid-liquid extraction has been patented and is soon to be brought into production, it is understood, which will effect a partial separation of the unsaturated drying-oil components of the soybean oil from the saturated components. Furfural and ethyl acetoacetate are two solvents used to illustrate this method in U. S. Patents Nos. 2,200,290 and 2,200,291, assigned to Pittsburgh Plate Glass Co.

### FOR OTHER OILS ALSO

Research is known to have been done on this idea independently at the Regional Soybean Laboratory of the U. S. Department of Agriculture at Urbana, Ill., and at the Pittsburgh Plate Glass Co.'s research laboratories. Other organizations may also have contributed. It is, of course, significant not only for soybean oil, but also for those other oils which contain appreciable proportions of the drying oil fatty acids. It is conceivable that the necessity for importing linseed, tung, and perilla oils may be considerably diminished by such solvent processing of domestic oils. And the benefit may be considerable for the food oils as well as for drying oils, first, because the saturated components will have greater value to the food manufacturer than the original oil had, and, second, because large scale application may serve to divert large amounts of semi-drying oils into industrial channels, possibly relieving the perennial surplus of domestic edible oils.

In the soap industry very little increase in the use of soybean oil has occurred in the past three years, nor

**Cracking rolls like these are used prior to oil recovery by extraction or expelling**

**Final step in the preparation for extraction is the pressing of the beans into thin flakes on this machine**

is it likely to increase as long as the oil is suitable for the higher value edible and drying uses. In the manufacture of miscellaneous products the use of soybean oil and derived fatty acids has been increasing in recent years, as would be expected with the larger supplies available. Makers of linoleum, printing inks, and waterproofed coatings for papers and textiles are among those who depend importantly on soybean oil. This increase will probably continue, with chemical engineers responsible in many cases for new uses and new techniques.

### PROCESSING THE MEAL

The soybean meal which is left after the oil is removed is fairly high in protein content (41 to 44 per cent, compared with typical cottonseed meal content of 39 per cent and linseed meal 37 per cent). It serves principally as a stock feed. Chemical engineering contributes even to this product, for example, in the toasting of the meal made by the solvent process. This was found necessary to develop the feed value to equal that of pressed meal, which is heated before and in the course of pressing. The heat, if properly applied in the presence of the correct amount of moisture, makes the proteins available in digestible form. Good toasting practice calls for a golden brown color in the product so that it may be sold to a consuming industry which traditionally expects all oil seed meals to look alike, regardless of the source or method of processing.

Since solvent meal contains less than 1 per cent residual oil, compared with pressed meal which contains 4 or 5 per cent oil, its protein content is 2 or 3 per cent higher than that of pressed meal. The extra amount of oil recovered by the solvent method, out of the original 18 or 20 per cent oil content of the soybean, more than makes up for any lowered value of the solvent meal as a feed because of its lower fat content. The feed manufacturer can, if he wishes, restore the fat content of solvent meal with fats which cost less than the recovered soybean oil is worth.

**Approximate Percentage Fatty Acid Composition of Soybean Oil**

| | |
|---|---|
| Palmitic acid ($C_{16}$, saturated) | 8 |
| Stearic acid ($C_{18}$, saturated) | 5 |
| Oleic acid ($C_{18}$, 1 double bond) | 27 |
| Linoleic acid ($C_{18}$, 2 double bonds) | 57 |
| Linolenic acid ($C_{18}$, 3 double bonds) | 3 |
| | 100 |

### MEAL USED IN PLASTICS

On the other hand the solvent meal because of its low oil content is much better adapted to the manufacture of plastics than is the pressed meal. Although considerable discussion has been heard of the use of soybean meal in plastics, there has not been a great amount actually used. The meal corresponds to a filler, though in part it does react with formaldehyde to form a low-quality plastic. A superior molding compound has been achieved by the use of this meal with phenol-formaldehyde plastic. This has been publicized to a considerable extent by the Ford Motor Co., which incidentally is doing considerable chemical engineering research on soybeans and soybean products. (See *Chem. & Met.*, April 1936, p. 172.)

### INDUSTRIAL PROTEINS

Industrial proteins are produced commercially from solvent extracted soybean meal, and the development of processes for obtaining these proteins in a relatively pure and usable form has been a major chemical engineering achievement. They find application in the manufacture of paper sizings, adhesives, laminated fiber board, water paints, and miscellaneous coatings. Small molded parts are also being produced from preparations containing phenolic or urea molding compositions in admixture with varying amounts of purified soybean protein pre-hardened with formaldehyde.

The large quantities of meal which have come onto the market in the past few years have significantly affected the sales of cottonseed meal and linseed meal. The fertilizer industry is also beginning to notice this new source of organic nitrogen, though the tonnage used has not become significant. Other uses for soybean meal which are of growing importance are found in a long list of foods—flour, macaroni, breads and other baked goods, infant and invalid foods, and others previously mentioned as products of dried beans.

### AND PROTEIN FIBERS

One large potential outlet for the meal is in the manufacture of a protein fiber by techniques comparable to those of other synthetic fibers already well known. This soy fiber has some of the properties of silk and some of those of wool. It is already in use in Japan, and we may see a domestic product on the market in this country before long. (Ford Motor Co. automobile upholstery.) The 25 per cent carbohydrate content of the meal is overshadowed by the protein, but important carbohydrate derivatives some day also may contribute to the long list of soybean products.

In conclusion, emphasis should be placed on the need for balanced markets in such a multi-product business. As the number of acres planted to soybeans increases each year, the effect of the soybean research is being felt over a wider range. We may already feed, clothe, and house ourselves with soybean products; and the chemical engineer has just begun to work with this interesting agricultural raw material.

**Soybean meal, source of numerous food materials for both man and beast, is bagged in 100 lb. lots in this manner**

# Recommended Practice for Handling Nitrocellulose

**Chem. & Met. INTERPRETATION**

**Our national preparedness program will call for the manufacture of tremendous amounts of nitrocellulose for use in smokeless powder. But this most important cellulose ester is also an ingredient or raw material used by many peace-time industries which will be expanded to meet other new defense requirements. The matter of safe handling of such a flammable material is of primary importance to all concerned with its manufacture, transportation or use. The Manufacturing Chemists' Association has issued Manual Sheet N-1 giving recommended practice for handling nitrocellulose. Certain of the information in this pamphlet is presented here.*— *Editors.***

NITROCELLULOSE is a flammable material, but when properly handled is not in itself necessarily hazardous. The reasonable precautions outlined below should be followed as a guide for the protection of both life and property.

*Handling Containers*—All barrels that contain nitrocellulose should be handled carefully, never allowed to slide and never dropped. Wooden skids for rolling barrels should be used if there is a difference of elevation and the package always kept under control. If power-driven handling equipment is used to move or transport barrels, make sure that the barrels cannot be dropped, squeezed, ruptured or damaged. If barrels of nitrocellulose are to be transported or moved in a motor vehicle, be sure that the equipment is in good condition and fire-safe. Do not transport nitrocellulose with other material or equipment that might cause or contribute to an accident.

*Storage*—Before storing make sure that the barrel closures are airtight in order to prevent loss of solvents by evaporation. Barrels should preferably be stored in suitable buildings reasonably well removed from other plant structures, dwellings, roads and streets. Although considered less desirable, barrels may also be stored out-of-doors.

Storage buildings should be sprinklered and may be of fire-resisting or ordinary frame construction depending upon the location. It is desirable to provide vent areas in the form of venting windows. Type of sprinklers, heating and illumination, floors and aisles are of great importance and should be of approved type or form.

Barrels may be stored two tiers high; the second tier resting on boards protecting the heads of the first. Mechanical equipment may be used for stacking, but it should be a type approved for the work.

Under no circumstance should barrels of nitrocellulose be opened in the storage building.

*In Process*—Keep the amount of exposed nitrocellulose to a minimum. Nitrocellulose should be kept wet either with solvents or with water. To accomplish this, barrels should be tightly covered to prevent evaporation of the liquid; rooms and machines, where practical, should be frequently washed down with water; sweepings should be placed in a covered waste container and wet down with water immediately.

See that there are no open flames or sparks in or near the room or building in which nitrocellulose materials are stored or used. Employees in or near such buildings should not be permitted to smoke, carry matches or lighters.

Sparks from electrical equipment, "struck" sparks and static discharges are potential sources of danger. Electrical equipment should conform to the Underwriters' requirements for Class 1, Group D locations. Nonferrous tools and floors, and brass nails in employee's shoes will lessen the possibility of struck sparks. Precautions against static discharges include low-resistance ground connections on processing equipment, static collectors on conveyors and transmission belts, use of non-ferrous metal containers, machine fasteners and tools, non-insulating soles on workmen's shoes, and conducting (non-ferrous) floor surfaces.

*Empty Barrels*—After emptying, the barrels should be wiped clean with a rag or cloth that is free from metallic particles. The head should be put on and the sealing ring drawn up. The rags after use should be placed in a covered waste container, wet down with water, and disposed of by burning in a safe location.

*Mechanical Work and Repairs*—Repair work should not be carried out if nitrocellulose or other flammable material is in or near the machinery or equipment. Flammable material should be removed to a safe location and, if practical, water used to wet down the machine or equipment and the area around it. Work should never be done on valves, fittings or other pieces of equipment used for processing nitrocellulose until such pieces have been thoroughly cleaned and nitrocellulose residues removed.

*Fire Prevention and Protection*—Water is an effective extinguishing medium for nitrocellulose fires and should be used in large quantities. Fumes from burning nitrocellulose are poisonous. Gas masks should be readily available, and those concerned should be thoroughly familiar with their location and use.

High heat on barrels of nitrocellulose will cause vaporization of solvents with consequent pressure, resulting in ultimate explosion of the barrels. Men fighting such fires should keep well in the clear and out of range.

Fire blankets and safety water showers should be available. Adequate sprinkler protection should also be available. Fire fighting equipment must be adequate and in good condition; access to it must not be blocked. Employees should know where it is located and how to use each piece. Building exits should be free and unobstructed with at least two exits to each room.

"Good Housekeeping" should be maintained at all times. Barrels should be kept clean from sand, cinders and dirt. Employees' work clothes should be without pockets or cuffs and should have no exposed metal buttons. Work clothes should be changed often and before they get very dirty. They should not be worn outside of working areas.

*Priced at 10 cents, Manual Sheet N-1 is obtainable from the M.C.A., 608 Woodward Building, Washington, D. C. It should be consulted for complete and detailed information.— Editor.

# Humidity Damage to Buildings and Means for Its Prevention

**C. R. DOWNS** *Weiss & Downs, Inc. and Calorider Corp., New York, N. Y.*

**J. W. SPISELMAN** *Research Corp., New York, N. Y.*

**Chem. & Met. INTERPRETATION**

**Recent years have witnessed the intensification of a problem affecting many types of building construction. This is the damage to structures or to paint caused by the condensation of moisture on or within cold wall and roof surfaces, either during the winter-time or when low indoor temperatures are carried in the summer. Changes both in the methods of operating buildings and in the structures themselves have amplified the trouble. The cure lies either in structural changes which recognize the problem, or in proper humidity control to avoid too high a moisture concentration.**— *Editors.*

ARCHITECTS, engineers, building materials manufacturers and building owners have recently awakened to the fact that current trends in construction of certain types of buildings, coupled with the present-day tendency to carry higher humidity than formerly during the winter-time, have greatly increased the potentiality for moisture damage due to condensation from the air. Such damage manifests itself in exterior paint deterioration, putty loosening in windows, staining of wall decorations and even in the rotting of wooden, or the corrosion of metal, structural members. The problem has become particularly noteworthy in residences of modern "improved" construction, but it is also found in some types of commercial establishments and industrial buildings, particularly where high humidity is carried in winter for comfort, or on account of process requirements. A similar kind of damage is sometimes encountered in refrigerated spaces and in summer air conditioning installations where condensation of moisture, if not prevented, may take place on walls or cold air supply ducts.

The problem is one that should interest chemical engineers not alone because of the possibility of damage to structures with which they are concerned, but also because the improved methods and materials which will be forthcoming to avert such damage will probably be developed and produced largely by chemical process industries.

In general there are two principal methods whereby condensation damage can be prevented: (1) By carrying lower humidity within the structure; and (2) by structural means, which will prevent moisture in large enough concentration to permit condensation, from reaching or being retained at the cold parts of the structure. The first method, which depends upon suitable limitation of moisture release (and in some cases even upon dehumidification of the air) may not always be acceptable owing to process requirements (e.g., in paper and rayon mills and printing plants). Hence improved methods of construction may be essential for some types of buildings. In other cases, however, no serious disadvantage exists in reducing the humidity by whatever means is required, and for such buildings present structural methods and materials will frequently be adequate.

## THE PROBLEM

Wall and roof condensation is not a new phenomenon by any means, but developments of the last few years have emphasized the likelihood of its taking place. Condensation will occur, of course, whenever water vapor is reduced to a temperature below its dewpoint, as when air of fairly high temperature and high humidity comes in contact with the cold wall of the building. When the air temperature falls at the cold wall, saturation of the air is attained, followed by the condensation of part of the moisture upon further cooling.

Furthermore, moisture contained in air or other gas will diffuse with considerable rapidity through most non-metallic building materials whenever a moisture vapor pressure difference exists across the separating member, the mechanism of the transfer varying with the temperature conditions. (See Frank B. Rowley, Climate and Housing, *Sigma Xi Quarterly*, Autumn, 1939.) Such wall materials as wood, plaster, plasterboard and wallboard, offer little resistance to the passage of moisture from the interior of a structure into the wall, provided a vapor pressure difference exists, as is likely in winter when outside air is usually of low moisture content and inside air often of much higher vapor pressure owing to intentional or inadvertent addition of moisture to it. Therefore, the fact that the inner surface of the wall of a frame structure is above the dewpoint of the indoor air offers no assurance that condensation will not take place within the wall. On the contrary, many present trends seem designed to make certain that condensation *will* take place, within the wall where it cannot readily be detected.

Condensation assumes numerous aspects, of course, depending on the type of construction employed. A common type of single-story industrial building is that using steel framing, brick or tile curtain walls, a sawtooth or monitor roof and large areas of window glass and steel sash in walls and monitor. With air of high humidity in such a building, and a low outside temperature, condensa-

tion takes place chiefly on the glass, but also to some extent on the under surface of the roof, possibly dripping off to damage goods in process and, in all likelihood, rusting the building steel and the window sash. Where ventilation or dehumidification cannot be used to relieve the situation, about the only remedy is insulation of the roof and provision of gutters to catch the window drip, but even here roof damage may result behind the insulation if the latter is of a type pervious to water vapor.

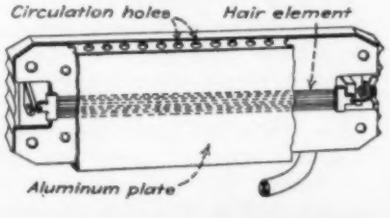
The insidious character of wall condensation can best be demonstrated in the type of frame construction commonly used for residences. Formerly, in residences wall condensation was rarely, if ever, a factor. Construction was not so tight as it is today, interior temperatures were lower and intentional humidification was not practiced to any considerable extent. With open fireplaces and stoves in use, moisture released into the house was adequately vented through the chimney, while loose doors and windows and less tightly constructed walls assisted in frequent air changes. Today, however, various factors have contributed to the retention of the moisture in the air. Central heating, less pervious building papers and weatherstripping are all in common use. The practice of fire-stopping has decreased air circulation within walls, as has the frequent employment of fill type insulations.

Frame construction today commonly consists of vertical studding on the exterior of which is a layer of wood sheathing covered with building paper and siding or shingles. Inside the studding is the plaster base and plaster, or wallboard. Between the studding is often some type of insulation, frequently a complete fill. The first and intended effect of this construction is to raise the inner wall temperature as compared with an uninsulated wall and so to increase comfort by reducing drafts and radiation. However, the second and unintended effect is largely to reduce the rate of passage to the outer atmosphere of moisture which diffuses into the wall space, thus permitting its condensation within the insulation or against the outer sheathing during cold weather. Insulation, it is to be noted, is not responsible for this condition except in so far as a fill type without air spaces inhibits circulation and thus retards ventilation to the outside. However, insulation does permit condensation to go on unnoticed within the wall space, by carrying the position of dewpoint temperature out of sight, away from the inner wall, thus encouraging the building owner to employ a higher indoor humidity than is justified by the construction.

The advantages of higher humidities of air in winter living spaces are obvious so far as the effect on plants, woodwork, furniture and fabrics is concerned. They are not so obvious nor so certain with regard to human physiology. It is clear, however, that high winter humidity cannot be carried without building damage under present methods of construction and the new methods now under consideration, or still newer ones not yet developed, will have to be employed before inhabitants of the colder sections can regularly enjoy with impunity a winter humidity of 40 or 50 per cent.

One unexpected consequence of higher indoor humidity has been an alarming increase in exterior paint peeling and blistering. This subject has been investigated by the du Pont company (Iliff and Davis, *Ind. Eng. Chem.*, Nov. 1939, p. 1407 and Dec. 1939, p. 1446) and it has been shown conclusively that all common types of paint tend to separate from wood when the wood attains a rather high moisture content in the range from about 16 to 28 per cent. Using test buildings with various typical sorts of frame construction, the investigators found that the conditions causing blistering and peeling could easily be induced in winter under ordinary residence conditions provided means were not used to prevent access of moisture to the rear of the paint film. They found further that separation of the film could be prevented even with high interior humidity when proper precautions were taken in the wall construction.

**Friez "Windowstat," showing how it is constructed and how it is used**



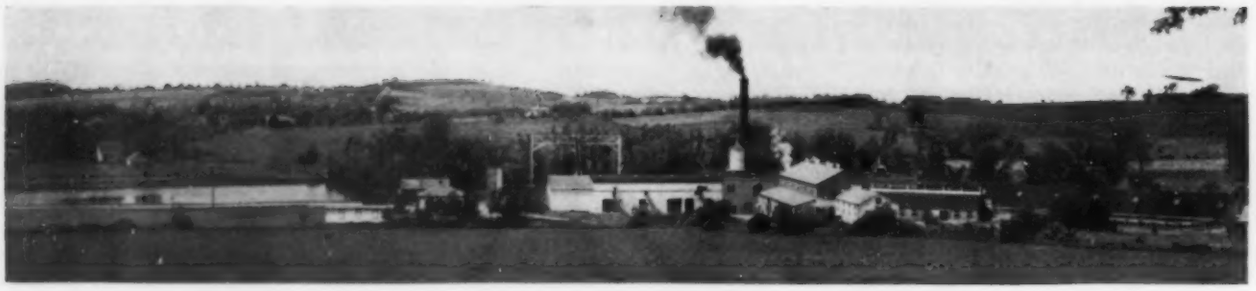
### POSSIBLE SOLUTIONS

If wall condensation is to be avoided, then, as noted above, either the moisture in the air must be prevented from reaching a surface which is below its dewpoint, or the air must be lowered in dewpoint below the lowest temperature it will encounter in the structure. In the main, the first solution, while the ideal, is not easy to achieve in existing buildings, particularly residences, although to an extent, it can be approached. Where a high winter humidity is not essential, the second solution is the more certain and can be attained by proper control of the sources of humidity in relation to the weather.

Attempts have been made to employ an outdoor thermostat linked to an indoor humidistat, so designed that the humidistat is automatically reset to an assumed safe point as the outdoor temperature falls. This arrangement, however, does not take into consideration the increased heat transmission of building materials with increased wind velocity. Furthermore, its expense is a deterrent. A much simpler arrangement developed by the authors (U. S. Patent No. 2,210,656) is available in one form as the "Windowstat" provided by Julien P. Friez & Sons, Baltimore. This device is a hair humidistat which is supported close to the glass of a window (without storm sash) so that the thermal circulation of air cooled by heat transmission through the pane contacts the humidistatic element. Since a window (preferably one on the north) is normally the best heat transmitting element in a structure, the air passing the element will be the coldest and hence at the highest relative humidity that air within the walls will reach. Thus if the humidistat is set to shut off the humidifier or start a ventilator or dehumidifier when the air cooled by the window reaches 90 per cent relative humidity, trouble from condensation will not usually be encountered.

There is, however, this exception: weather changes in winter may be rapid and extreme, as for example, when a test residence record on Feb. 15, 1939, showed a temperature drop from 62 deg. F. at noon to 15 deg. F. at midnight. If only a window humidistat were used it would be possible for the interior humidity to go so high during the warm period that

(*Please turn to page 625*)



Small rural-located industrial plant with water supply pond at left

# How Process Industries Are Meeting Their Water Supply Problems

GRAHAM L. MONTGOMERY
*Associate Editor, Food Industries, New York, N. Y.*

**Chem. & Met. INTERPRETATION**

**Necessity for relocation of industries and the expansion of existing plants as part of the defense program are only a part of the reason why chemical process industries are looking more closely than ever before at problems relating to water supply. Not only must new supplies of sufficient quantity and good quality be found in some cases, but in others increased cost of water following a period of receding levels must be offset by greater efficiency in water pumping. Two later articles in this series of three will present case studies in modern pumping, the first relating to primary water supply, the second to process water and liquor handling.** —*Editors.*

FIVE YEARS of drought in the mid-1930's, with receding water levels in wells, shrinking reservoirs, ponds and lakes, and diminishing stream flow, made the management of most process industries acutely conscious of the water supply problem of their plants. So now, with national defense preparation and increased export business expanding production, improved water supply facilities are being actively sought. Recent sales records of manufacturers of water pumping equipment show that many large process industry plants are doing something about their water problems.

What are these problems? First, there is the necessity of obtaining a continuous supply of water in sufficient quantity to meet the needs of the process, to provide fire protection, and to take care of the power plant and process steam requirements. That is no mean problem, because the process industries are well up near the top in the list of industrial users of water.

For example, consider the manufacture of industrial alcohol. Normal water requirements range around 50 gal. for each gallon of alcohol produced. As the annual production is over 180,000,000 gal., it is evident that plants producing this chemical require more than 9 billion gal. of water per year.

Sulphuric acid is, perhaps, the most important of all heavy chemical products. Plants manufacturing this acid require around 3 billion gal. of water per year. Other acids such as nitric and acetic have water requirements in comparable range.

Alkali production also requires the use of large quantities of water. Requirements of the producers of soda ash, if lumped together, about equal the demand of a city of 1,000,000 inhabitants. Lime caustic soda production requires more than 1 billion gal. of water per year; and electrolytic caustic soda and chlorine production is also a large user of water. Potash production requires 30,000 gal. of water supply for every ton of output.

These examples have all been taken from the heavy chemical industry; but if one turns to the other chemical process industries, one finds the same sort of picture. For instance, cellulose nitrate manufacture requires 50 gal. of water for each pound of product and the total requirement of the industry is more than 1 billion gal. per year. Portland cement output requires about 20 billion gal. annually and the production of rayon demands approximately the same quantity. Leather tanning plants taken together use some 2½ billion gal. of water each year. Pulp and paper manufacture demands extremely large quantities of water. Gasoline production requires close to 10 billion gal. annually. Soap and glycerine accounts for 1½ billion gal. each year. And cottonseed oil crushing and refining uses about 3 billion gal.

It is evident from these figures that the manufacture of the products of chemical process industries is dependent upon a large and continuous supply of water. In some of these industries it is also true that the quality of the water is im-

portant. Water characteristics such as the amount of hardness, the presence or absence of certain minerals, pH value and the quantity of oxygen present, are often important. Paper manufacture and leather tanning both require soft water, for example. In times past, before the development of adequate softening methods for water, paper mills and tanneries tended to be located in places where abundant supplies of soft water were available and even today such locations are likely to offer economic advantages for these industries. Also, industries using large quantities of process steam find economy in locating where treatment of boiler water for boiler scale elimination is not expensive.

While the characteristic of "softness" or lack of dissolved compounds of calcium, magnesium and sodium is the most widely sought after among the characteristics of natural water, absence of certain other minerals is important. Iron is frequently found in water supplies and its presence is detrimental in many manufacturing processes. Iron tends to impart undesired colors. It also contaminates products by its presence. Strangely enough, much of the iron found in water supplies was not originally there, but was dissolved from pumps, pipes or other iron equipment with which the water came into contact. Certain types of water which, upon analysis, prove to be of high purity have this property of dissolving iron to a marked degree.

Waters with high oxygen content tend to be extremely active in corroding equipment. For this reason, many modern boiler plants pass all feed water through a deaerator before use. Deaerators also serve this purpose in protecting processing equipment from corrosion.

Finally, pH is of importance, as low pH indicates the presence of acidity in the water. Acid often comes from mines or from the waste products of industrial plants. Waters containing such acid wastes are not suitable for use in process industry plants unless treated to neutralize the acidity.

Hardness of water, in general, can be taken as an index of its suitability for industrial use and of the amount of treatment necessary. Reference to the map, Fig. 1, will show that water varies rather widely in different sections of the United States in hardness, as measured in parts per million of equivalent $CaCO_3$. This is, of course, only a rough picture, as waters vary widely even

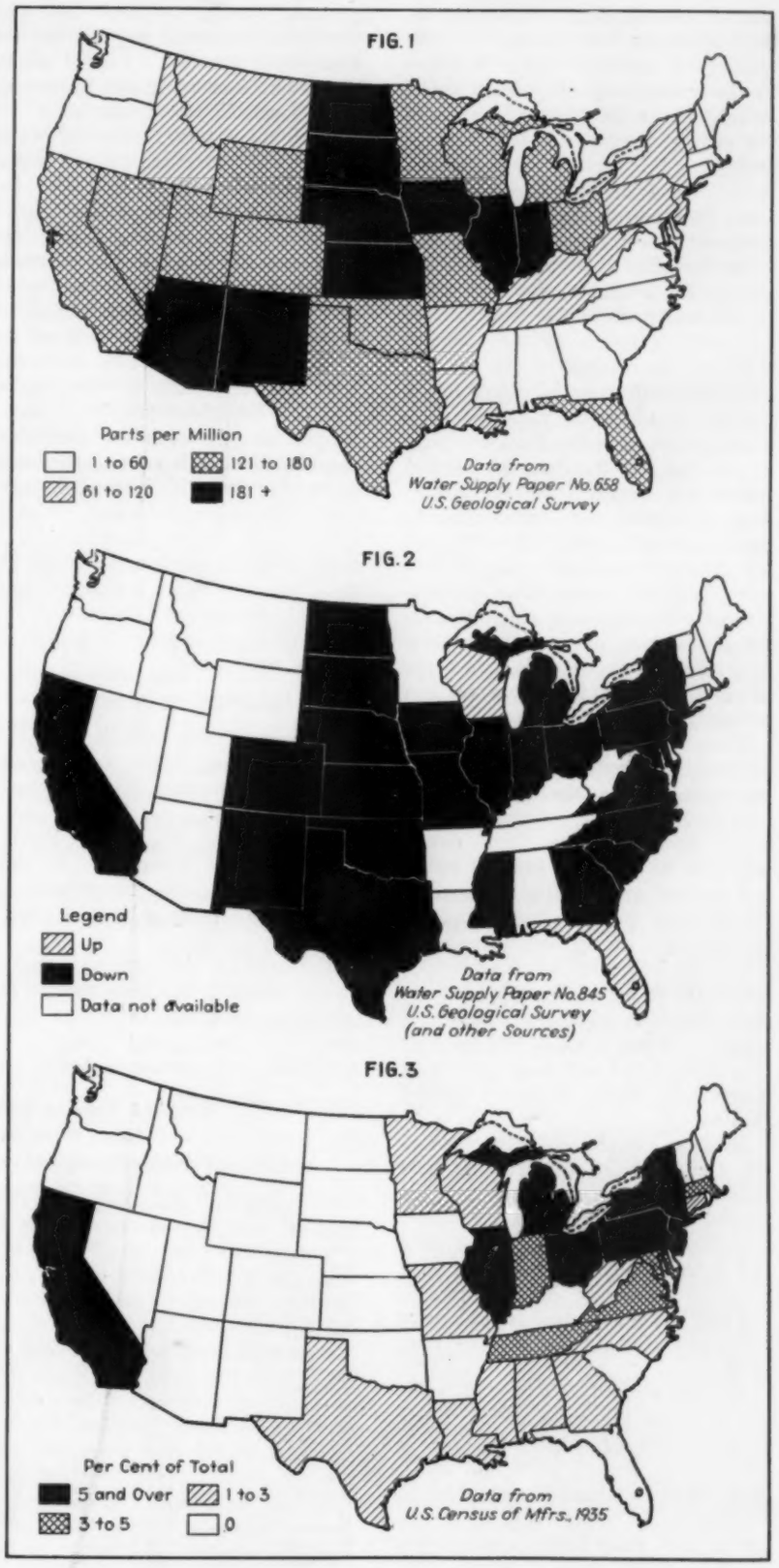



**Fig. 1—Weighted average hardness, by states, of public water supplies**

**Fig. 2—Rising and falling levels of ground waters in various states in recent years, showing effects of droughts and heavy pumping**

**Fig. 3—Densities of chemical process industries, by states, showing heavier concentrations in seaboard and Great Lakes areas**

within a single state. However, the map serves as a rough guide to the quality of available water supplies in the various regions. More detail is available in the table, which shows the average hardness of both surface and ground waters in various states. Note that ground waters, that is, those from deep wells, tend to greater hardness.

Incidentally, this matter of the quality of available water supplies in different parts of the country is of particular interest at the present time. Defense preparations call for construction of essential plants in the interior of the country, between the Appalachians and the Rockies. This is just the region where the hardest waters are found, while the Northeast, Southeast and Northwest contain abundant supplies of water with low hardness and low mineral content. It is this geographical distribution of soft waters, as much as anything, that has governed the location of textile and paper mills, two types of operation in which soft water is a necessity.

Even more important to the chemical process industries than quality of water supply is the assurance of availability. Two sources are at hand: surface waters from rivers, lakes, catch basins or shallow wells; and ground waters from deep wells. Plants may provide for their own supply, by choosing sites adjacent to rivers or lakes, or by constructing reservoirs or wells. Or water may be furnished from an existing municipal supply. Often, a plant will have its own supply and also a connection to a municipal system to insure against failure.

Mention has already been made of the trend toward constructing new plants in the central part of the United States, away from the coasts. Unfortunately, this region not only suffers the disadvantage of water supplies of relatively great hardness, but also has experienced several years of severe drought during the past decade.

Ground water levels in wells seem to be upon the upgrade in many states at present, when compared to the low points of 1936 and 1937. But, when comparison is made to conditions 40 years ago, it is apparent that water levels in most parts of the country show a definite lowering. This condition affects not only the water level in shallow or deep wells, but also tends to lower the average level in streams, lakes and reservoirs, as more of the rainfall is absorbed and held in the ground, failing to find its way through springs and seepage into the rivers and streams. Fig. 2 shows states with increasing and decreasing water levels in recent years.

How these two factors of water supply and water quality may affect the chemical process industries becomes evident by comparing Figs. 1 and 2 with Fig. 3, which shows the location of process industry plants at the present time. This last map shows that the greatest concentration of chemical process industries is on the Atlantic, Gulf and Pacific seaboards, with relatively little in the interior part of the country. With water supply already such an important consideration, it is sure to command more attention with increased manufacture in the central states. Waters available in those states are of a quality that demands considerable expenditure for water treatment, particularly because of high mineral content and to avoid scale formation on and in equipment.

## SAVINGS IN PUMPING

Because of the necessity for this water treatment, water supply costs will become greater. The only compensating saving that appears to be readily available lies in reducing the cost of water pumping. If such savings can be made, the overall costs of water supply should not be greatly increased.

Fortunately, the pump manufacturing industry has been making engineering progress in recent years and now many pump designs are available that operate at better efficiency than former designs and also cost less to install and maintain. New plants that are erected will take advantage of this improved pumping equipment. Also, existing plants may find it worthwhile to re-equip with new pumps, or can install new pumps when replacements are made.

Pumps are the key to this matter of water supply because, from whatever source water may be obtained, the plant must, in most instances, have its own pumping system to supply pressure for fire protection and for distributing water to points of use. City water pressure is seldom sufficient to serve the needs of the processing plant, and when the supply is from a river, lake or reservoir, or from wells, the pumping system is a necessity for bringing water to the plant as well as for supplying pressure.

Almost all of the types of pump that have ever been invented, in addition to the air-lift (which raises water by means of compressed air) have been used by the process industries for pumping water and other liquids. More recently, pumping equipment has usually been one of two types—centrifugal pumps for general service, and rotary or gear pumps for specific applications requiring positive delivery. For water supply, the centrifugal pump is the generally accepted standard, as it is also for the pumping of most liquids during processing.

Pumping operations can be classified into two groups: low head and high head. For high head work it is customary to use so-called "multi-

**Weighted Average Hardness as Calcium Carbonate of Large Water Supplies in Various States**

(Data from Water Supply Paper No. 658, U. S. Geological Survey)

| State | Avg. P. P. M. Calcium $CO_3$ Surface | Ground | All | State | Avg. P. P. M. Calcium $CO_3$ Surface | Ground | All |
|---|---|---|---|---|---|---|---|
| Alabama | 53 | 50 | 52 | Nebraska | 251 | 150 | 213 |
| Arizona | ... | 207 | 207 | Nevada | 83 | 187 | 143 |
| Arkansas | 133 | 44 | 106 | New Hampshire | 11 | 35 | 19 |
| California | 128 | 150 | 133 | New Jersey | 53 | 128 | 71 |
| Colorado | 122 | ... | 122 | New Mexico | 62 | 259 | 205 |
| Connecticut | 24 | ... | 24 | New York | | | |
| Delaware | 48 | 85 | 53 | N. Y. City | 29 | 108 | 40 |
| Dist. Columbia | 90 | ... | 90 | Up-state | 88 | 174 | 93 |
| Florida | 81 | 173 | 148 | All state | 47 | 117 | 55 |
| Georgia | 18 | 116 | 41 | North Carolina | 25 | 95 | 28 |
| Idaho | 74 | 99 | 85 | North Dakota | 153 | 262 | 185 |
| Illinois | | | | Ohio | 125 | 333 | 160 |
| Lake Mich | 125 | ... | 125 | Oklahoma | 139 | 246 | 156 |
| Other | 142 | 345 | 237 | Oregon | 10 | 29 | 13 |
| All | 127 | 345 | 148 | Pennsylvania | 78 | 203 | 83 |
| Indiana | 199 | 361 | 243 | Rhode Island | 28 | 24 | 27 |
| Iowa | 160 | 347 | 277 | South Carolina | 22 | 24 | 22 |
| Kansas | 187 | 401 | 274 | South Dakota | 239 | 478 | 395 |
| Kentucky | 105 | ... | 105 | Tennessee | 82 | 44 | 65 |
| Louisiana | 65 | 43 | 62 | Texas | 127 | 143 | 135 |
| Maine | 15 | ... | 15 | Utah | 170 | 174 | 171 |
| Maryland | 53 | 21 | 53 | Vermont | 63 | ... | 63 |
| Massachusetts | 19 | 47 | 21 | Virginia | 43 | 164 | 56 |
| Michigan | 114 | 303 | 137 | Washington | 22 | 112 | 41 |
| Minnesota | 154 | 290 | 173 | West Virginia | 71 | 172 | 93 |
| Mississippi | 52 | 27 | 36 | Wisconsin | 129 | 247 | 163 |
| Missouri | 133 | 276 | 134 | Wyoming | 106 | 224 | 154 |
| Montana | 94 | 234 | 98 | Avg. for U. S. | 85 | 191 | 102 |

stage" pumps, which are in effect several pumps in series. This type of pump is used for raising water from deep wells, for pumping water to levels high above the pump, as in high buildings, or for pumping against high pressures, as in boiler feedwater supply. Single-stage pumps are generally adequate for raising water from shallow wells, streams or reservoirs; or for pumping water or other liquids around the plant.

Essentially, a centrifugal pump consists of two parts, an impeller and a casing. The impeller consists of a number of blades of various designs mounted on an axis, similar in general to a fan or propeller. The simplest type of casing is merely an annular space around the impeller. This has the disadvantage of not being very efficient because the entering water sets up eddies in the casing. A more efficient type is the volute casing, commonly used on most general-purpose centrifugal pumps. The most efficient type of casing interposes vanes in the path of the incoming water and pumps built in this manner are called "turbine" pumps. Turbine pumps are used particularly for high head work, as they permit the efficient operation of several impellers in series to form a "multi-stage" pump.

### WHAT PUMPS ARE USED

In modern practice multi-stage turbine pumps operating vertically, that is, on a vertical axis, are most generally used for raising water from deep wells. In such an installation the pump is lowered into the well until it is submerged and is operated by a drive shaft extending down into the well from the surface, supported at suitable intervals by bearings; or, in some instances, the pump is operated from a submerged electric motor located below the pump. In either case, such a pump has the advantage of running submerged, that is, the water level in the well is above the pump. This makes for efficient, trouble-free operation, a condition that does not hold when a centrifugal pump must suck water up to the level of its suction.

In medium head operation, in wells and when pumping from streams or reservoirs, a vertical centrifugal pump similar to the multi-stage deep-well turbine pump, but with somewhat different design of impeller, has been found to possess the needed characteristics.

In pumping water from shallow wells or otherwise against low heads a vertical pump of different design is useful. This pump is called the axial flow or propeller pump. In place of the usual type of impeller, a screw or propeller is used, similar to a ship's screw. The usual type of casing is not required, as the screw propeller delivers water through itself, parallel to the axis of rotation. Such a pump will deliver large quantities of water efficiently at low heads and its simplicity and low first cost make it suitable for installations where its low delivery head suffices.

While all of these pumps were developed for the pumping of water from wells, streams or reservoirs, they have certain features that are causing them to find application in other locations. Their space requirements are all relatively small, they can be conveniently inserted in a short vertical rise in a pipeline and their drive, be it motor, or pulley, can be kept off the floor, out of the way, if desired.

## HUMIDITY DAMAGE

(*Continued from page* 621)

infiltration or ventilation could not lower it safely in step with the rapidly falling outside temperature. To handle this situation the authors have developed a simple modification of the window humidistat system, whereby a second humidistat in series with the first and exposed to the average room air acts as a limiting control, holding the inside humidity to, say, 35 or 40 per cent regardless of the outside temperature. (U. S. Patent No. 2,171,109.)

The window control has a variety of similar applications. For example, it may be used to control a dehumidifier (or humidifier and dehumidifier) in manufacturing or storage spaces. It can control the supply of cooling agent passing through a surface cooler to avoid condensation in the cooler. A modified form may be employed in summer to fix a safe minimum temperature in refrigerated spaces to avoid structural damage due to condensation.

### STRUCTURAL IMPROVEMENTS

When reduction in humidity cannot be practiced as a deterrent to condensation, then the remaining recourse is by some means to limit the quantity of vapor that can accumulate in contact with the cold parts of the structure. As previously shown, most ordinary wall materials pass vapor readily. Hence either an adequate vapor seal must be used to keep the vapor in the higher temperature parts of the structure, or the cold parts must be so well ventilated that vapor cannot accumulate to a concentration high enough to condense. Modern residence construction, for example, reverses these requirements. Through the use of so-called "improved" building paper on the *outside* of the cold part of the wall, moisture which diffuses readily into the cold spaces is retained, in which retention the fire-stops and the insulation also assist. Instead, structural means should be provided for ventilating the wall outside the insulation and in addition, if possible, a vapor sealing membrane which is largely impervious to moisture diffusion should be provided *inside* the studding, and under the plaster or other inner wall surface. Adequate inside vapor seals in the form of metal foils are now available, but construction technique will have to be improved if much benefit is to be secured from their use to insure that all channels for diffusion into the wall structure will be stopped with sufficient completeness.

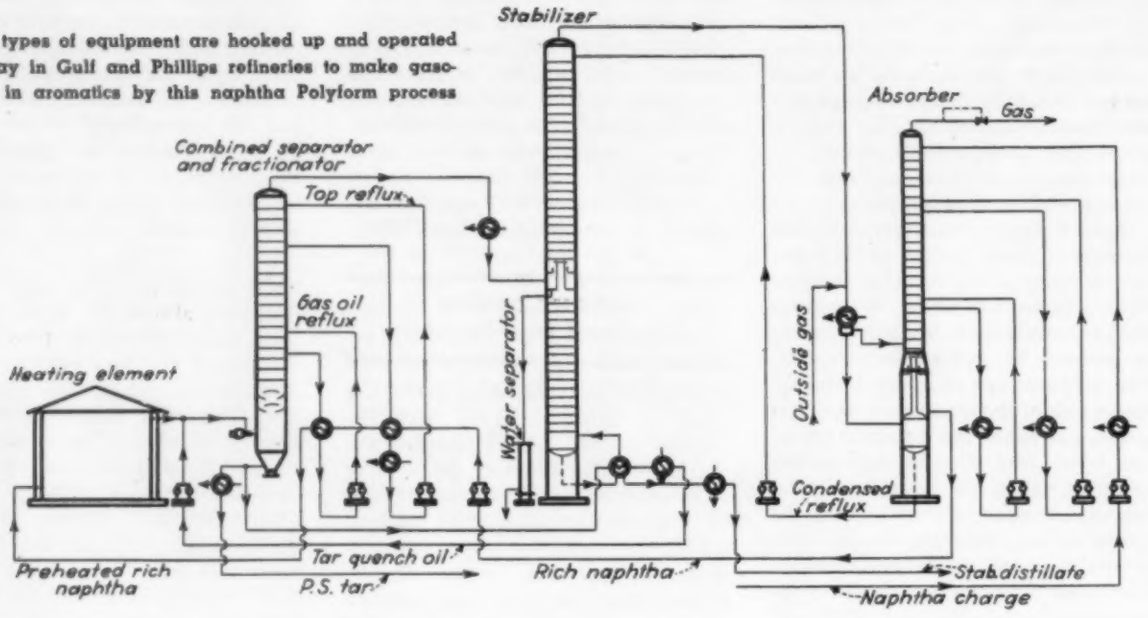
### NEW MATERIALS

Plywoods made with synthetic resin cements may be another solution, as well as other impervious synthetic or metal-covered materials. Investigations of various types of paint coatings over the plaster and of certain improved building papers have shown that some of these materials serve adequately as inside vapor seals. (See Rowley, *loc. cit.;* Univ. Illinois Bull. Vol. 36, p. 104, 1939; and bulletins of the Forest Products Laboratory, Madison, Wis.)

Only the main outlines of the subject have been broached here, but it is hoped that the fundamentals advanced will prove suggestive and provocative of further study. One more suggestion should be noted in closing. The idea has been advanced by Iliff and Davis (*loc. cit.*), and others, that one possible solution to the paint peeling problem, barring the use of satisfactory condensation-preventing methods, may be the development of vapor-pervious paints which will permit the ventilation of wood to prevent its saturation by condensation. This scheme would seem to be decidedly worthy of investigation by the paint industry, as would the idea of abandoning the misleading, previously used method of testing house paints by means of test panels.

# Gulf Introduces New Petroleum Refining

Standard types of equipment are hooked up and operated a new way in Gulf and Phillips refineries to make gasoline high in aromatics by this naphtha Polyform process




**Chem. & Met. INTERPRETATION**

**Disclosure of the new Polyform process of the Gulf Oil Corp. was made this month in a comprehensive paper by Povl Ostergaard of that company and E. R. Smoley of The Lummus Co. Because the process utilizes a unique method of shortening the carbon chain of a charged oil while at the same time lengthening the chain of added hydrocarbon gases, it illustrates once more the chemical aspects of petroleum refining. We feel that chemical engineers will be interested not only in the principles of the process, but in the high octane number and aromatic content of the product. So we have abstracted the paper, choosing portions of chemical significance.**—*Editors.*

ANOTHER STEP in the petroleum industry's march toward higher gasoline yields and higher octane numbers has been taken. Gulf Oil Corp. has developed a process that combines polymerization with cracking in a unique manner, called Polyforming. The Polyform process differs from thermal cracking in that the oil is processed in admixture with normally gaseous hydrocarbons, particularly propane and butane, at higher temperatures and pressures. The result is a higher degree of conversion per pass with a consequent increase in yield and octane number.

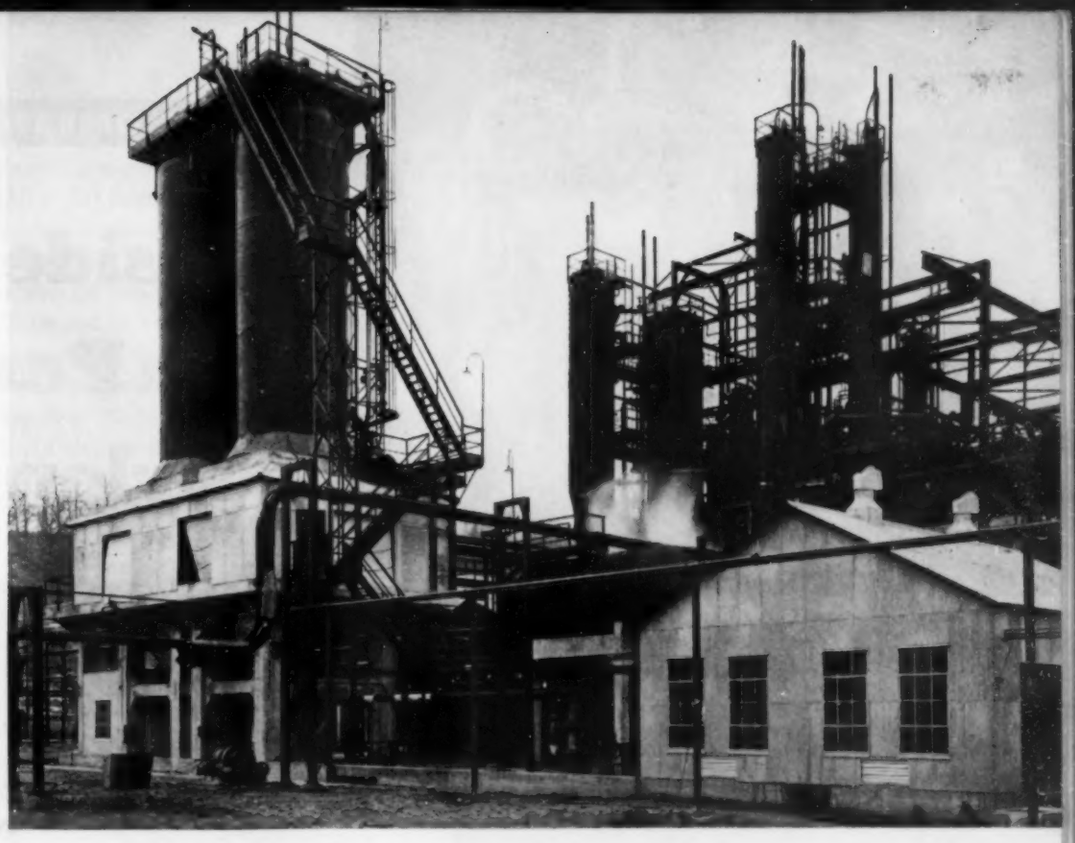
At present five of the new units are in operation in Gulf refineries and five more in refineries of Phillips Petroleum Co. (Phillips calls them "gas reversion" units) with capacities ranging from 1,500 to 22,000 bbl. per day. The Lummus Co. is now engaged in the construction of two more naphtha Polyform units, one 10,000 and one 4,000 bbl. per day capacity. The larger unit is for an unnamed Gulf Coast refiner and the smaller is for the Gulf Oil Corp. The process is now being offered to the entire refining industry.

The theory of the process is that in addition to the normal cracking of long hydrocarbon molecules which is obtained at these high temperatures and pressures (about 1,000 deg. F. and 1,000 lb. per sq.in.) a certain amount of polymerization of the $C_3$ and $C_4$ hydrocarbons will occur. Also the introduction of the gases cuts down coke formation, allowing the unit to operate at higher temperatures with the consequent increase in conversion per pass.

The principle of the process is that the charge to the furnace must be one continuous phase. Normally, the liquid phase tends to be suspended in the vapor phase (largely the gaseous additives) in the form of minute droplets. These are thrown out against the tube wall forming a thin oil film. Heat transmitted through the tube wall must pass through this oil film which therefore determines the coking characteristics of the tube. In order to produce a continuous vapor phase, the proportion of light hydrocarbons must be increased to a point where the critical temperature of the mixture is reduced to the temperature of operation. This does away with the oil film, substituting a vapor film, which is less susceptible to coking.

The simplest type of once-through Polyform unit is illustrated in the accompanying flow sheet. This type of unit is particularly adapted to Polyforming of naphthas, kerosene and light furnace oils, with simultaneous polymerization of $C_3$ and $C_4$ hydrocarbons from other cracking units. The ordinary types of equipment—heater, separating and fractionating tower, stabilizer and absorber—are used.

# Process



**Naphtha Polyforming unit equipped with coke drums at the Cincinnati refinery of Gulf Oil Corp. The unit charges 2,800 bbl. per day of mid-continent naphtha, 1,900 bbl. per day of propane and butane and 2,400 bbl. per day of visbroken tar**

The cold naphtha charge is used for absorption oil in the absorber, which is equipped with side stream coolers for removal of heat of absorption and for controlling gas circulation and rate of absorption. Rich oil from the absorber constitutes the furnace charge. This system eliminates the necessity for installing a complete absorption and stripping system for recovery of the liquid gas fresh feed and recycle. Ordinarily, outside gases can be charged directly into the naphtha absorber if in liquid phase or into vapor lines between stabilizer and precondenser if in the vapor phase.

Recirculated bottoms from the combined separating and fractionating tower are used for quench oil to the tube outlet ahead of the reducing valve in order to avoid coke formation in the transfer line and separating tower. Excess heat in the tar quench oil is usually sufficient for satisfactory reboiling of the polyform distillate in the stabilizer. The combined naphtha and absorbed gas furnace charge is preheated to approximately 500 to 550 deg. F. in trap tray and gas oil side stream high pressure heat exchangers before entering the furnace. The furnace is usually designed with two chambers, one heating section and one soaking section, to permit full control of reaction.

Typical operating conditions for this type of unit are:

Back pressure on heating element, 1,000 to 1,500 lb. per sq.in.

Tower pressure, 300 to 400 lb. per sq.in.

Outlet temperature from heaters, 1,020 to 1,125 deg. F.

Yields of about 77 per cent of a 400 deg. F. end-point gasoline with an octane rating of 75 (CFR-ASTM clear) are typical from a Mid-continent naphtha as shown in the accompanying table. From the more naphthenic crudes such as East Venezuelan, a yield of 84 per cent of 76 octane number may be obtained. However, results can be altered at will by changing the proportion of gaseous hydrocarbons charged, the type of oil used, or the operating conditions. In all cases the product is of high quality. It may have a spread of 10 to 12 points in octane rating between the CFR-ASTM method and the CFR-Research method. In addition the octane number is practically constant over a wide boiling range. Blending value and lead susceptibility are unusually high. A typical stabilized Polyformed distillate from a 50-50 mix of Mid-continent and Pennsylvania naphtha, 24-34 per cent on crude, was tested as follows: A.P.I. gravity, 56.7; acid heat, 113; aniline point, 70 deg. F.; vapor pressure at 100 deg. F., 11.5 lb. per sq. in. ASTM distillation data in deg. F. were: over point, 95; end point, 412; 10 per cent point, 120; 50 per cent point, 264; and 90 per cent point, 368. On this sample the unleaded octane number by CFR-ASTM was 75.1; by the research method, 87.1.

As previously noted, the unit described here is the simplest type. Two- and four-coil combination units are also built which will charge anything from crude oil to a low-grade gasoline.

Modified Polyform units may be used for the production of aviation gasoline of 77-80 octane rating, which can be boosted to 90 octane by the addition of less than 3 cc. per gal. of tetraethyl lead. This Polyform distillate is high in aromatics, particularly toluol and xylol (about 11 and 13 per cent respectively), a fact which may be of special significance in the event of a war-time emergency.

**Comparison of Crack per Pass, Polyform vs. Conventional Thermal Cracking**

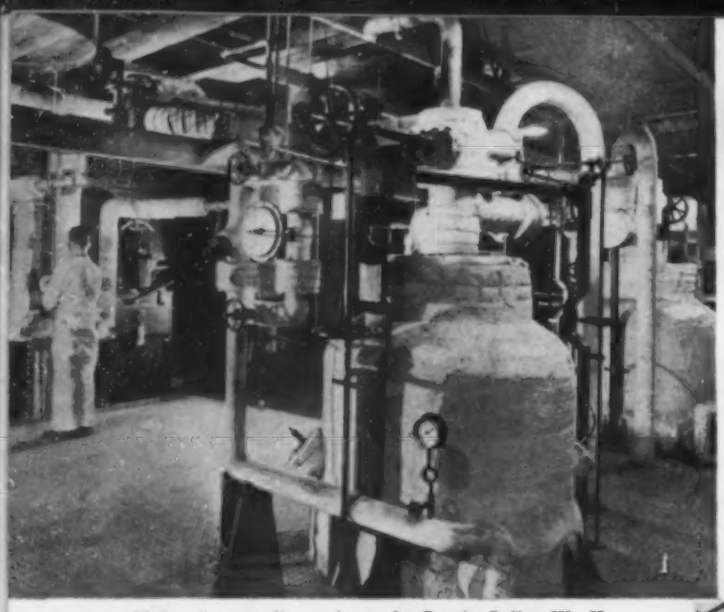
(400 end-point gasoline by volume)

| Properties | Mid Continent P.S. Stock | | Mid Continent Naphtha | |
|---|---|---|---|---|
| Gravity: deg. A.P.I... | 26.0 | | 50 0 | |
| Assay distillation | | | | |
| Over point: Deg. F.. | 265 | | 270 | |
| 10 % at..... | 451 | | 302 | |
| 50 % ..... | 626 | | 336 | |
| 90 % ..... | ..... | | 378 | |
| Mol. Weight..... | 270 | | 125 | |
| Characterization factor | 11.5 | | 11.8 | |
| Vol.% liq. gas $C_3+C_4$ | None | 53.8 | None | 49.2 |
| Cracking temp. deg. F. | 900 | 985 | 1,000 | 1,030 |
| Pressure lb./sq. in. Ga. | 200 | 750 | 1,100 | 1,100 |
| % Gasoline/pass..... | 18 | 41.3 | 70.1 | 77.2 |
| Octane No. gasoline... | 65.0 | 70.0 | 71.7 | 75.1 |

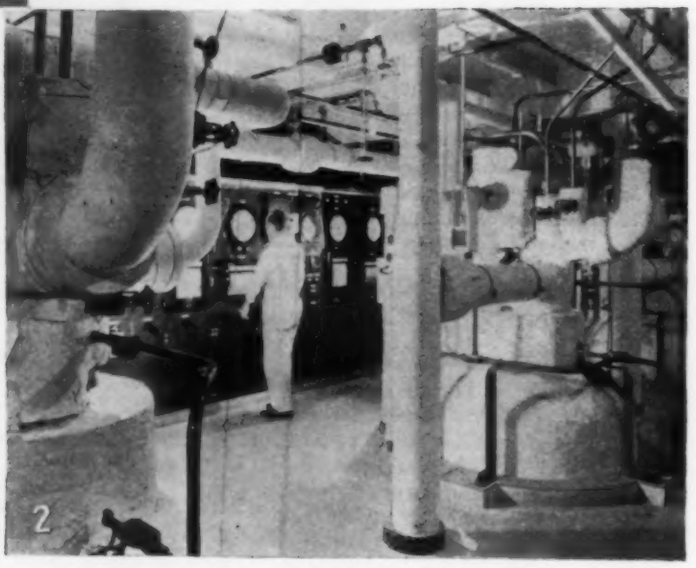
These data from commercial units with 2,000 hour average length runs.

CHEMICAL OPERATIONS

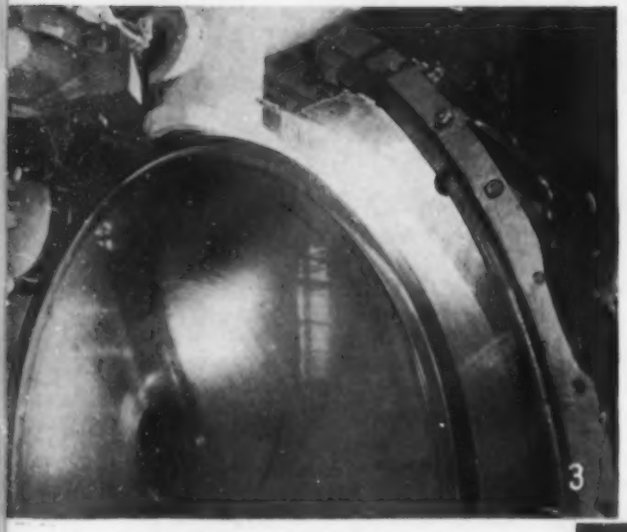
# Inside du Pont's New Nylon Plant



Nylon intermediates from du Pont's Belle, W. Va. plant are pumped into these water evaporators

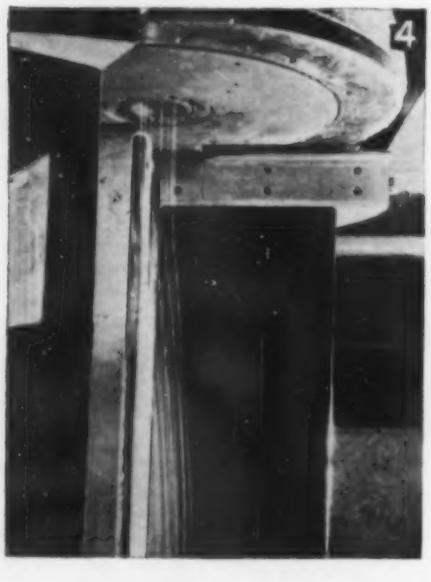


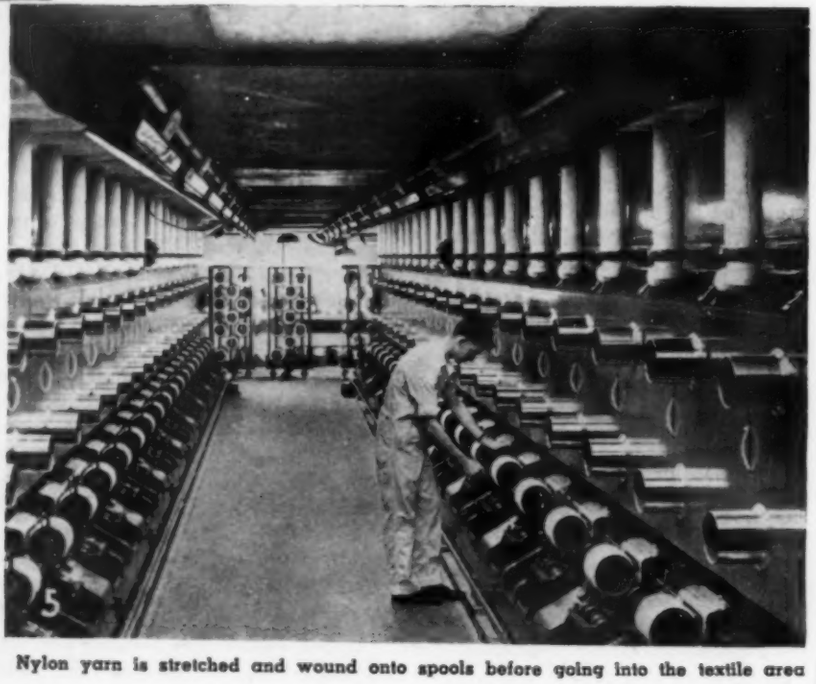
Polymerization of diamines and dibasic acids occurs in autoclaves



Molten polymer, extruded on this casting wheel and water sprayed, solidifies

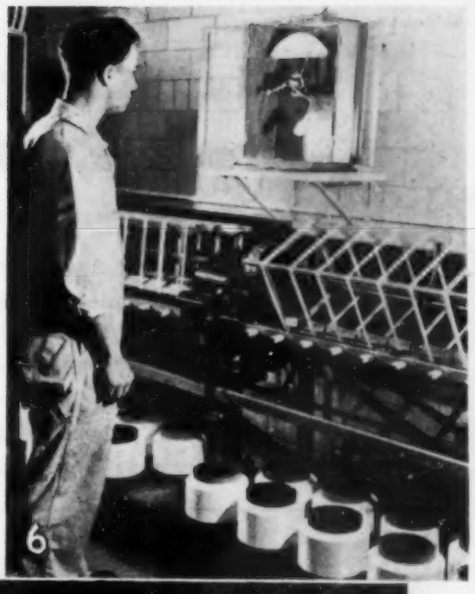
Solid strips are chopped, melted then extruded to filaments by spinnerets



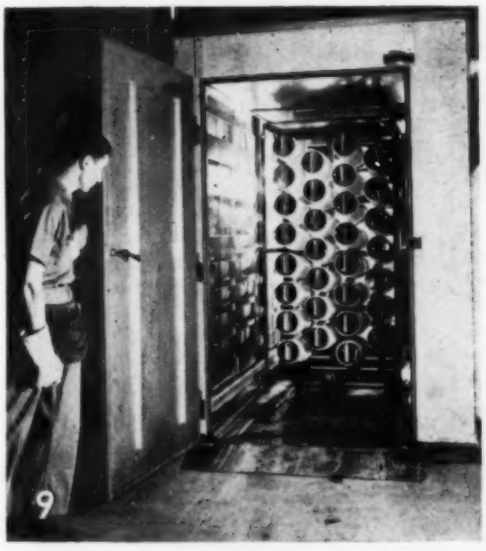


Nylon yarn is stretched and wound onto spools before going into the textile area

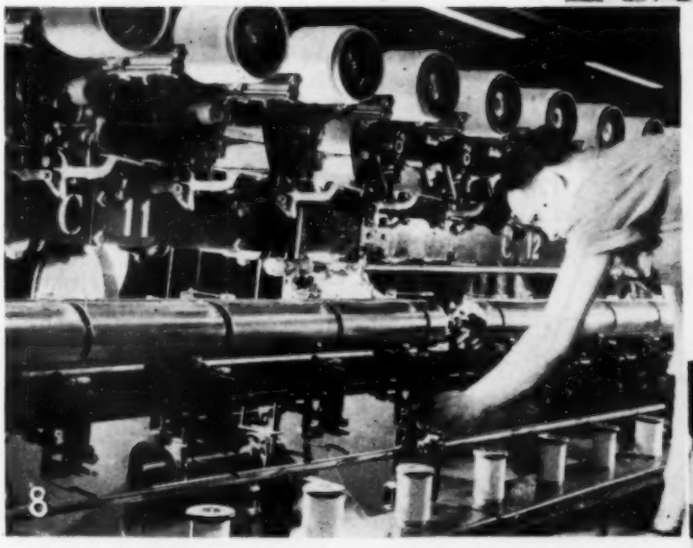
Most people have heard the miracle story of nylon hosiery in past months and know that it is made by regular hosiery manufacturers using the synthetic fiber purchased from E. I. du Pont de Nemours & Co. But little information on the actual manufacturing operations carried on inside du Pont's $15,000,000 plant at Seaford, Del., has been made available. Much of the story is told here in pictures taken by William M. Ritasse, some of them released now for the first time. Chemical operations have been grouped in sequence on the opposite page and textile operations are shown on this page. An abstract of Dr. Hoff's American Chemical Society paper "Nylon as a Textile Fiber" appears on page 650 of this issue.




Weight is checked to insure uniform denier in the yarn

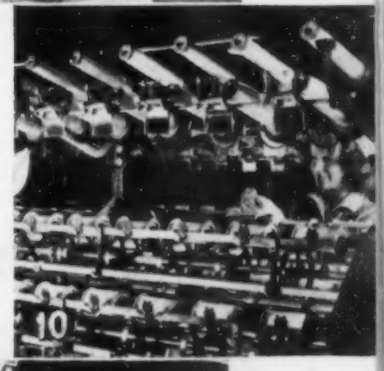



Nylon yarn is "baked" in twist setting ovens




A protective coating or sizing is applied at this point by contact with a gummy substance. It is removed in finishing

Every section of the plant is completely air - conditioned via these large ducts




Spools of nylon getting their last windup before shipping to customers

Yarn inspection is final step at Seaford

## TEXTILE OPERATIONS

# Sodium Chlorite Produces Stronger, Whiter Paper

**Chem. & Met. INTERPRETATION**

**Unique properties of this new heavy chemical simplify wood pulp bleaching and give promise of new economies in textile finishing and other widely used industrial processes according to recent report to pulp and paper technologists. Of special importance at this time is the claim that it may make this country independent of the high-grade kraft pulp now made only in Scandinavia and no longer available because of war conditions—*Editors.***

ADVANTAGES of using sodium chlorite for bleaching wood pulp were outlined at the recent meeting in Seattle, Wash., of the Technical Association of the Pulp and Paper Industry in a contribution by J. F. White and G. P. Vincent of the research and development department, Mathieson Alkali Works.

These advantages are, according to the authors, high brightness without loss of fiber strength, small loss of brightness with time, no loss of the desirable chemical properties of the pulp, and elimination of the need for rigid chemical control of the bleaching process.

A large number of tests made by Dr. White and Dr. Vincent on paper prepared from pulp bleached by chlorite and hypochlorite gave results of which those shown in Table I and Fig. 1 are typical.

Similar results showing that fiber strength is not affected by chlorite bleaching were obtained with sulphite stock.

It was stated by the authors that the use of chlorite did not lower and sometimes increased the cuprammonium viscosity of the resulting cellulose and that there is a slight increase in the alpha-cellulose content above that obtained with hypochlorite bleaching. The use of chlorite, the authors conclude, does not produce effects which indicate degradation of the cellulose.

Chlorite in a form suitable for use in bleaching wood pulp will shortly be produced in quantity by Mathieson under the name of "C2."

Sodium chlorite exists in two solid forms, the anhydrous $NaClO_2$ and the trihydrate $NaClO_2 3H_2O$. As the former is non-hygroscopic, does not seriously cake in storage, and contains more active oxygen per lb., it is the form in which chlorite is supplied commercially. Chlorites other than the sodium compound can be prepared but so far no commercial application has been found for them.

Chlorite is very stable both in the solid form and in solution, and can be heated to 150 deg. C. without decomposition. It is very soluble in water, a saturated solution at 30 deg. C. containing 46 per cent by weight of $NaClO_2$. In acid solutions, $NaClO_2$ yields $HClO_2$, $ClO_2$, and some NaCl and $NaClO_3$. The exact reaction varies with conditions, but neither chlorine or $Cl_2O$ is produced.

**Fig. 1. Effect of bleaching agents on paper made with kraft pulps**

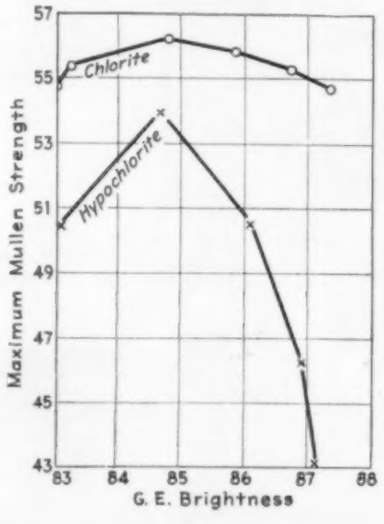



**Table 1. Properties of Paper Made with Kraft Pulp Bleached to High Brightness**

| Treatment of Pulp Used | No. of Tests Averaged | GE Brightness | GE Brightness after 1 yr. | Maximum Mullen Strength | Tear at 70 sec. Freeness |
|---|---|---|---|---|---|
| Bleached with chlorite | 14 | 86.6 | 84.5 | 53.0 | 45.6 |
| Bleached with hypochlorite | 7 | 86.4 | 80.3 | 45.8 | 39.4 |
| Original | 5 | 79.4 | 78.6 | 51.5 | 47.5 |

The oxidation potential of chlorite is 0.79 volt at pH 4 and 0.66 volt at pH 9. The oxidation potential of sodium hypochlorite at the same concentration of "available chlorine" is 1.2 volt to 0.95 volt throughout its normal bleaching range of pH 7 to 10. The lower value for chlorite explains its property of bleaching coloring matter without attacking cellulose. Chemically, this difference is due to the fact that chlorite releases $ClO_2$ on decomposition, while hypochlorite releases the more active Cl and $Cl_2O$. (See Fig. 2.) Chlorite is a stronger oxidizing agent than peroxide.

When chlorine is passed through a strong solution of chlorite, $ClO_2$ is formed in accordance with the following equation:

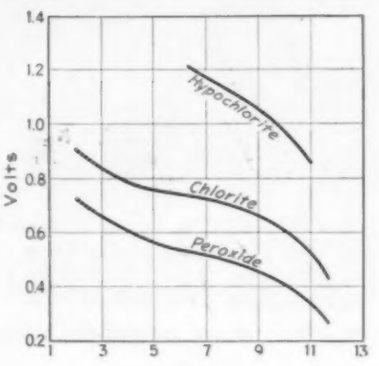
$2NaClO_2 + Cl_2 = 2\ NaCl + 2\ ClO_2$

can be produced commercially by this process. Solutions of sodium chlorite and sodium hypochlorite react, forming sodium chloride, sodium chlorate, and $ClO_2$.

Mixtures of chlorite and chlorine or hypochlorite, or both, can be used for bleaching, with results characteristic of chlorite and not of the stronger bleaching agents. This fact is of practical importance in bleaching wood pulp and other fibers.

Like the hypochlorites and the chlorates, chlorite must be handled with care, but it presents no hazards that prevent its general use under proper control. Its reaction with sulphur, however, deserves special mention. A mixture of chlorite and sulphur will ignite if rubbed or slightly moistened. There is enough sulphur in a rubber stopper to cause a slight pop when rubbed on moist chlorite. Hence, bottles containing chlorite should have glass or cork stoppers and the salt should not be handled with rubber gloves.

**Fig. 2. Oxidation potentials of bleaching agents referred to the normal hydrogen electrode. (Abscissa is pH)**



# Timesaving Ideas for Engineers

Chem & Met PLANT NOTEBOOK

## NOMOGRAPHIC PLOTTING PROVES CONVENIENT FOR VAPOR PRESSURE AND COMPOSITION DATA

DONALD F. OTHMER Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

EARLIER PAPERS by the author (A.I.Ch.E. meeting, Buffalo, May 13, 1940, and *Chem. & Met.*, May 1940, p. 296) have discussed a new method of plotting vapor pressure data which employs a type of log plot resulting in straight lines. On page 551 of the August 1940 issue of *Chem. & Met.* the author applied this plotting method to vapor pressure and vapor composition data for aqua ammonia solutions of various strengths. For ready use, however, a nomograph is a more convenient type of chart for the recording and employment of such data. Furthermore, a nomograph is easily constructed for this purpose, the simple construction following directly from the log-plot theory mentioned.

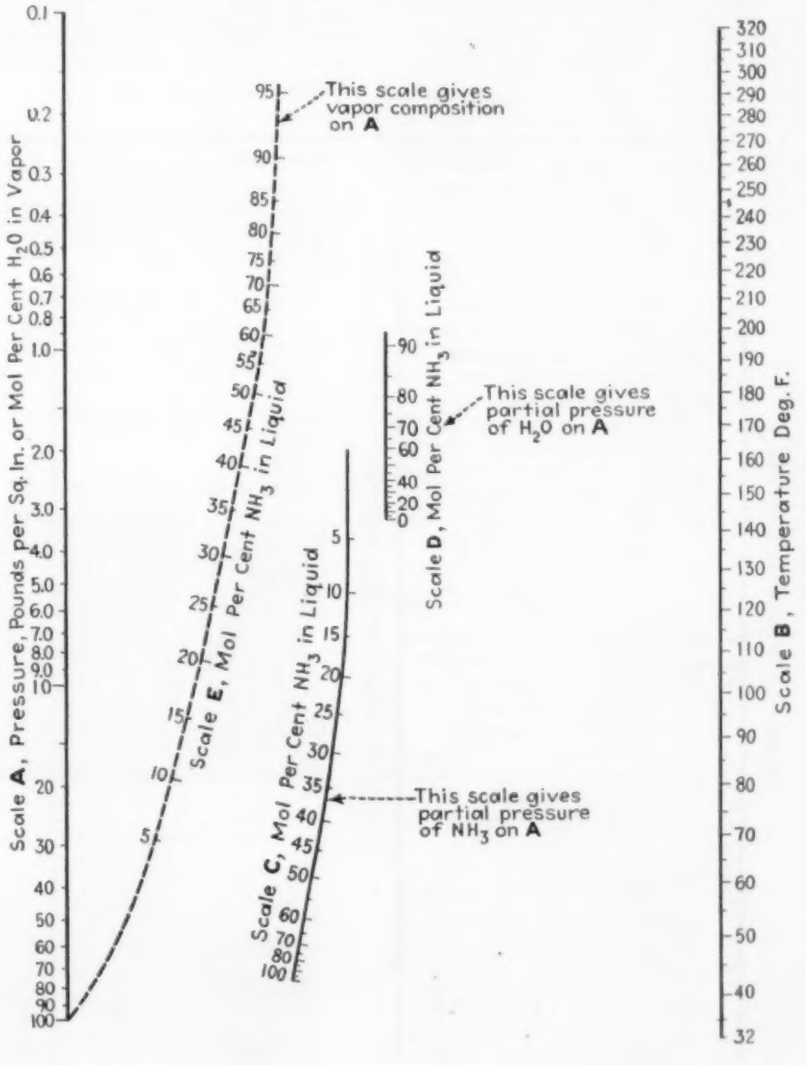
To make such a nomograph, as in the accompanying figure, calibrate a logarithmic scale downwardly on a line near the left edge of a sheet of paper, using either a suitable log scale such as a slide rule slider, or employing log paper. Parallel to this at the right side of the paper calibrate a second log scale of any convenient size, either larger or smaller than the first, but calibrate it in the opposite direction, i.e., upwardly. Temperatures are indicated on the right scale corresponding to the known vapor pressures of any desired reference substance as described in the earlier papers. To use this simple nomogram an intermediary point between the two scales must be found as the fulcrum for lines connecting the two, to be used in reading vapor pressures of any material at different temperatures. This point is found as the intersection of any two lines connecting two different temperatures on the right scale with the two corresponding vapor pressures on the left scale. Thus, for example, a line is drawn connecting the boiling point of the substance on the right scale with the value of the atmospheric pressure on the left scale. Another point on the temperature scale for which the vapor pressure is known is also connected by a straight line with the value of this vapor pressure on the scale at the left. The intersection of these two lines gives the fulcrum point; and any line through this point connecting the two scales gives directly the vapor pressure on the left scale corresponding to the temperature indicated on the right scale.

The accompanying chart has the left or pressure scale drawn and calibrated in pounds per square inch while the right and parallel temperature scale has been calibrated in degrees Fahrenheit (corresponding to vapor pressures of water on the original logarithmic calibration which is not shown).

The August paper gives lines for solutions of different strengths representing partial pressures of ammonia at different temperatures. Therefore, there will have to be one fulcrum point for each of these lines; and in the nomogram these have been determined and indicated as intersections of two or more lines representing vapor pressures at known temperatures. These intersections or fulcrum points fall along a curved line, scale C. Similarly, scale D shows the location of the fulcrum points determined for these solutions to indicate the partial pressures of water from the given ammonia solution on scale A at the corresponding temperatures on scale B.

In the particular case of these am-

**Partial pressure and vapor composition nomograph for aqua ammonia solutions**


Scale A, Pressure, Pounds per Sq. In. or Mol Per Cent $H_2O$ in Vapor
Scale E, Mol Per Cent $NH_3$ in Liquid
Scale C, Mol Per Cent $NH_3$ in Liquid
Scale D, Mol Per Cent $NH_3$ in Liquid
Scale B, Temperature Deg. F.
This scale gives vapor composition on A
This scale gives partial pressure of $H_2O$ on A
This scale gives partial pressure of $NH_3$ on A

monia solutions, it has been demonstrated that the mol percent of water in the vapor is also a logarithmic straight line function; and, therefore, scale A may be used to give the vapor composition in mol percent of water at any temperature shown on the scale B at the right. The fulcrum points are found by the intersection method to lie along the scale E.

Obviously, any number of points for any number of different materials can be plotted between the scales A and B and thus this same chart may be used for indicating the vapor pressures of any number of different materials. Because of the extreme simplicity of drafting (simply drawing two parallel logarithmic scales calibrated oppositely, laying off on one the temperature scale corresponding to the vapor pressure of some reference substance, and plotting of fulcrum points by intersecting lines drawn for two known values of vapor pressure and temperature) the nomogram can be readily constructed to any desired size for any system that may be desired.

## DETERMINING SLOPE OF INTERSECTION OF TWO SLANTING HOPPER SIDES

LEONARD SHAPIRO, Laboratory Director, Interlaken Mills, Fiskeville, R. I.

ARTICLES by Sandstrom (*Chem. & Met.*, Jan. 1940, p. 22) and Jacobsen (*Chem. & Met.*, July 1940, p. 480) have stressed the importance of designing hoppers so that the intersection of the sloping planes does not form an angle less than the angle of repose of the pulverized material.

The computation of the slope of this intersection is an interesting problem, and will be apparent from the following:

In Fig. 1, OBAC represents the corner of the hopper formed by the intersection of two planes whose angles with the horizontal are BOE and COF. The angle AOD, formed by OA and its projection OD on the horizontal plane, is the slope of the intersection.

If CAB is a right angle (and it usually is in a hopper), it may be demonstrated that its projection EDF on the horizontal plane forms a rectangle with O.

In the rectangle OEDF $(OD)^2 = (OE)^2 + (OF)^2$. If BE, AD and CF are taken as unity, then $OD = \cot AOD$, $OE = \cot BOE$, and $OF = \cot COF$. Hence $\cot^2 AOD = \cot^2 BOE + \cot^2 COF$. This simple relationship may be solved readily by means of the accompanying nomograph in Fig. 2.

*Example 1*—To find the intersection of two planes sloping 40 and 50 deg.,

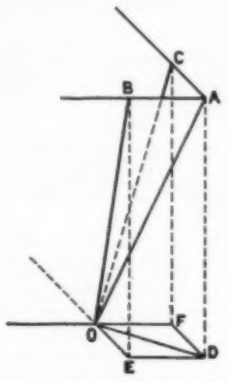
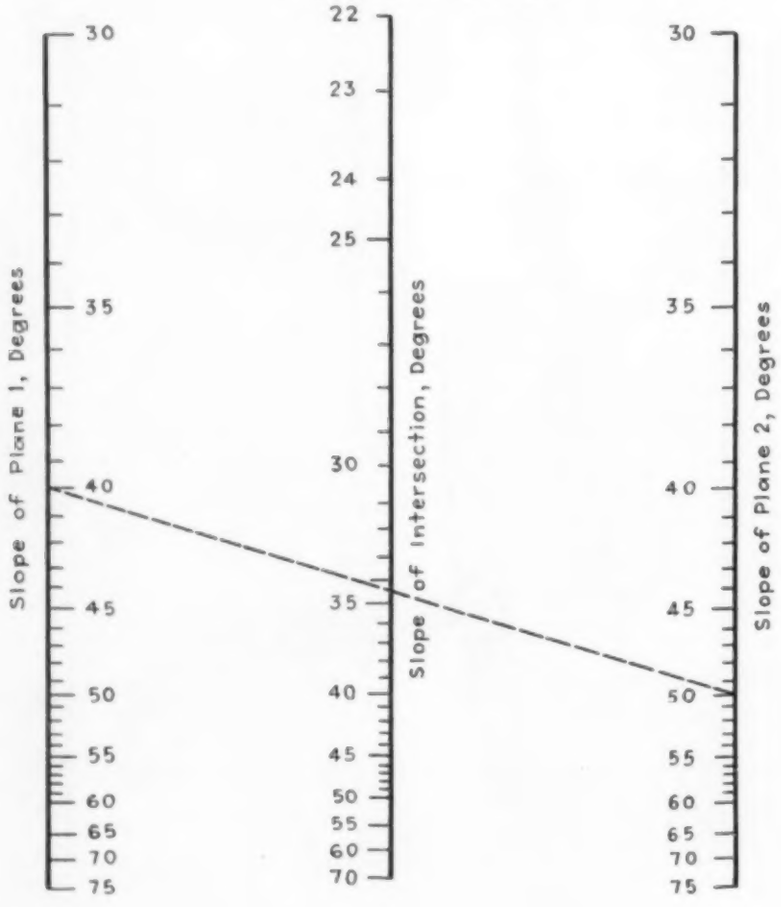



**Fig. 1—Hopper corner showing derivation of expression for slope of intersection**

connect 40 and 50 deg. on the two outer scales. At the intersection of the connecting line with the center scale, we read 34.5 deg., the slope of the intersection.

*Example 2*—If the angle of repose of the material is 45 deg., and we wish to employ planes having equal slopes, draw a horizontal line through 45 deg. on the center scale, and read the plane angles as 55 deg. on the outer scales.

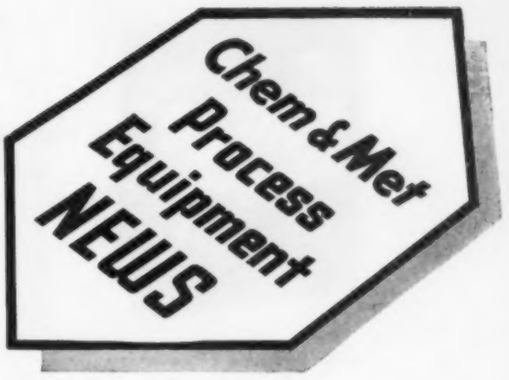
**Fig. 2—Nomograph for determining slope of intersection of two sloping planes (hopper sides) meeting at right angles**




## Dryer Heat Recovery

THAT it is sometimes possible to make a profitable recovery of the heat in air used for drying is pointed out in a recent issue of the Foster Wheeler Co.'s publication, *Heat Engineering*, in commenting on the performance of a "heating tower" installed at the Toronto, Ont., box board mill of the Gair Co. of Canada, Ltd. This tower, said to be one of a number of such installations in paper mills, is constructed similar to a cooling tower. Hot, moist air drawn from a hood over the dryer is forced through the tower counter to white water. The tower was designed to heat 230 Imp. g.p.m. of water from 75 to 120 deg. F., using the heat in 45,000 c.f.m. of air at 135 deg. F. dry bulb and 75 per cent R.H. The tower in tests has heated 330 Imp. g.p.m. from 88 to 111 deg. F. when the wet bulb temperature of the entering air was about 120 deg. This represented a recovery of 4,550,000 B.t.u. per hour, and with an average cost of heat of $0.25 per million B.t.u., resulted in a saving of about $1.13 per hour. This recovery has been in operation about two years at the Gair mill and is stated to be working satisfactorily, without spray carry-over, and without freezing even in coldest weather.

# Machinery, Materials and Products



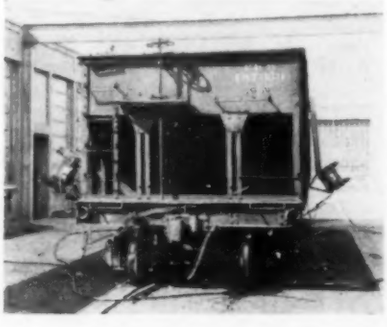

## Car Vibrators

DESIGNED to speed up the unloading of freight cars containing such materials as coal and other minerals, a large new vibrator fitted with hooks for attaching to hopper-bottom cars has been announced by the Syntron Co., 610 North Lexington Ave., Homer City, Pa. This vibrator is stated to be exceedingly powerful, weighing 950 lb. including the hook. It is used in pairs, two to a car, on opposite sides. Three thousand six hundred vibrations per minute are imparted to the car with the result, according to the manufacturer, that two men working with a pair of vibrators can unload a car of fine coal quicker than six or eight men can without the vibrators. Without the car hook, such vibrators can also be used on bunkers and storage bins to promote free-flowing discharge of material. Each vibrator is provided with a separate electrical control panel with thermionic valve and other necessary equipment. Single phase, 220-volt a.-c. current is required.

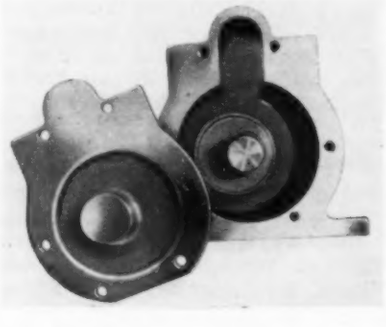
## Neoprene Pump

DEVELOPED originally in rubber for marine use by the Eco Engineering Co., Newark, N. J., a novel type of pump suggested for a wide range of industrial applications is now available employing a neoprene impeller said to withstand many severe pumping conditions. This pump, shown in the accompanying illustration, consists simply of an eccentric rotor, turning inside an impeller which is kept from rotating by a tongue held in a groove. Rotation of the eccentric forces the liquid out of one side of the pump by moving the impeller over to that side with a wiping action, and at the same time creating a suction on the other side. In the original rubber design, the rubber impeller permitted the passage of sand, grit and other foreign matter without damage, but for certain industrial applications rubber proved unsuitable owing to swelling and binding. Employment of neoprene is stated to have overcome this difficulty for many purposes.

Electric car vibrators in operation



Neoprene-impeller rotary pump



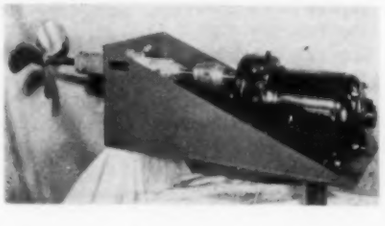
## Fork Truck

ABILITY to pass through 4-ft. aisles and through doorways 4½ ft. high, combined with a 2,000 lb. capacity and a 46-in. turning radius, are important features of the new small Cen-trol electric industrial fork truck recently announced by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland, Ohio. As employed by a paint manufacturer, three men using three skids and one of these trucks are able to reduce loading time in the shipping department to 40 min. per box-car when loading heavy fiberboard cases containing retail size paint cans. The cases are taken inside the freight car by truck and left there for hand unloading. When the skid is unloaded, the truck returns the empty skid to the shipping room, there picking up a filled skid. The truck operates at 5 mph.

In this same plant the truck is also used for weighing filled drums and cans on their way to the box-car. Another application is in the handling of bags, boxes and similar packages on light wooden pallets which are filled by hand and then transported and stacked for storage by truck.

Loading box-car with miniature truck

International side-entering agitator



## Improved Agitators

RECENTLY ANNOUNCED by the International Engineering Co., Dayton, Ohio, is a line of portable and permanent mixers available in a number of types and modifications. The portable mixer line includes a medium-duty, semi-laboratory type, in sizes from 1/30th to ¼ hp., while the heavy-duty industrial portables include direct-drive and geared-head mixers in sizes from ¼ to 5 hp. Splash-proof motors are standard, with totally-inclosed, air-cooled and explosion-proof motors available, if necessary. Propellers and shafts can be furnished in any desired material.

The company's permanent mixers comprise a variety of types including direct- and gear-driven models, employing vertical motors with or without integral speed reducer. Flange-mounted, leg-mounted, and stuffing-box types are available. Depending on the design, sizes range from ¾ to 50 hp., with propellers, turbines of various designs, and blade stirrers of various types available.

## New Products

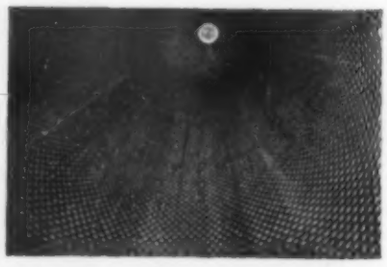
MOST RECENTLY developed of the industrial skin protection creams made by the Milburn Co., 905 Henry St., Detroit, Mich., is that called Ply No. 8. This is a practically invisible vanishing cream for arc welders and cutters which is claimed to prevent the skin burns which may result even through several layers of clothing, when flashes occur in the use of large diameter rods. The new cream is said to form a complete block to ultra-violet and other harmful rays, permitting the welder to be scantily clad and even leave his shirt open at the throat without danger.

NEW SPECIALIZED PRODUCTS compounded of natural and synthetic rub-

New deflection potentiometer

Adsco orifice-type flowmeter

Cutaway view of improved cyclonic dust collector



Hexsteel reinforcement spot welded inside a fractionating tower

bers, which nevertheless possess a high degree of electrical conductivity, have been developed recently in the research laboratories of The B. F. Goodrich Co., Akron, Ohio. The company has also announced the availability of synthetic rubber solutions which can be painted on to natural rubber and will carry away static. The conductivity can be controlled. In the case of static-carrying compounds for transmission belts, for example, a certain amount of resistance is needed to prevent sparking.

A NEW LIQUID FLUX for the bronze welding of both ferrous and non-ferrous metals has just been announced by The Linde Air Products Co., 30 East 42d St., New York, N. Y. Known as Oxweld Brazo Vapor Flux, the new material is said to be particularly suited to production work where the bronze welding is continuous, the sections to be joined are relatively light, and the joint is sufficiently exposed. A special dispenser is used, through which the welding acetylene is bubbled. Flux vapor is thus picked up and carried through the hose and blowpipe to the point of welding.

FERRO ENAMEL CORP., Cleveland, Ohio, has recently organized a wholly-owned subsidiary, the Liquid Plastic Corp., for the production of a new line of Vedoc synthetic finishes for use on sheet metal products of all types. The new low-fusing finishes supplement the company's regular line of porcelain enamels, and colors for enamels, inks, glazes, etc.

## Portable Pyrometer

WHAT IS DESCRIBED as a fundamentally new type of portable potentiometer pyrometer for measuring temperatures up to 3,000 deg. F. by means of a thermocouple is the Model 70-PO instrument recently announced by J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn. The instrument employs a unique circuit requiring no standard cell but only a flashlight cell. Total weight is less than 5½ lb. and vibration and adverse effects of ambient temperature variation have been minimized. Guaranteed accuracy is stated to be ½ of 1 per cent of total scale deflection. Automatic cold junction compensation inside the case is provided to handle ambient temperatures from —40 to +120 deg. F. Simplified operation, with virtual elimination of balancing on certain scale ranges is an important feature.

## Simplified Flowmeter

ANNOUNCEMENT has recently been made by the American District Steam Co., North Tonawanda, N. Y., of the development of the new Adsco orifice-type flowmeter. This instrument is available in four models for recording only, recording and integrating, recording and indicating, and recording, indicating and integrating. The meter is of the type which automatically compensates for the square-root relation, encountered in orifice-operated meters. Thus an evenly divided chart and simplified integrator can be employed. The compensating device is of a new type, consisting of a moving mercury container balanced by means of a suspension spring. Into the mercury dips a fixed bell having a contour designed to give straight-line recording characteristics.

Attached to the moving container is a magnet with a soft-iron pole piece situated within a stainless-steel, non-magnetic tube. Outside the tube and operating the meter mechanism are a pair of follower magnets which are attached to the pole piece of the internal magnet so as to follow its movement accurately. This method of transmission is both leakproof and frictionless, according to the manufacturer. It is claimed that the transmission is made of the most powerful magnet steel available, having a coupling power some ten times that of the best materials available a few years ago.

The meter is available for two maximum differentials, either 80 or 180 in. w.g. Meter bodies are tested to 1,500 lb. pressure, or double the working pressure, whichever is greater.

## Gunite Reinforcement

A NEW USE for an old product, Hexsteel Surface Armor, has been announced by Wm. F. Klemp Co., 6641 South Melvina Ave., Chicago, Ill. This material, it is claimed, has been found well suited for reinforcing protective linings such as gunite and ganister inside fractionating towers and other refinery and processing equipment. Hexsteel is a steel mat formed by clinching continuous strips of die-formed steel to produce hexagonal openings. Welded to the interior wall of a vessel in any one of several practical ways the material offers a holding surface of either ¾ or 1½ in. depth for the application of the protective coating material. Hexsteel Armor is available in steel with a variety of finishes, stainless steel and various non-ferrous alloys.

## Cyclone Dust Collector

HIGH EFFICIENCY is claimed for the new American cyclone dust collector recently developed by the American Foundry Equipment Co., 580 South Byrkit St., Mishawaka, Ind. This collector, which is of the long-cone type, operates in a manner similar to other cyclones, but is claimed to show exceptional efficiency owing to careful proportioning of the various parts. Relatively low back pressure is also claimed. The collecting efficiency is said to be close to that of filter type collectors for average dusts, and the same as the average wet collector. Furthermore, it is stated that the air volume can be varied materially from rated capacity without serious effect on the efficiency. The construction is indicated in the accompanying cutaway view. Collectors are built of heavy gage metal, with dust hoppers and supports designed according to the requirements of the particular installation.

## Equipment Briefs

FOR THE CONTROL of gas heating equipment, gas humidifiers, diaphragm valves and the like, Julien P. Friez & Sons, Division of Bendix Aviation Corp., Baltimore, Md., has announced

a new series of single-port magnetic gas valves in four sizes from ¼ to ½ in. The self-adjusting valve of Monel metal is operated by a flapper type armature. All internal parts are electrically tinned to guard against corrosion. Valves can be supplied for either 110 or 25 volts.

TWO RECENT APPLICATIONS of neoprene are described by the Rubber Chemicals Division of E. I. du Pont de Nemours & Co., Wilmington, Del. One is a development of the Manheim Manufacturing & Belting Co., Manheim, Pa., a novel type of V-belt consisting of short sections of V-cross-section belt which are fastened by buttoning the bottom of one end of one section to the top of the other end of another section. Thus a complete belt can be formed by joining together sufficient sections, and the belt can be installed or removed by simply hooking or unhooking any two sections. Such belts are now available in neoprene-bound fabric. Among the records established by the new belts is mentioned the case where a compressor manufacturer employed one in an application where earlier belts, operating in a spray of oil, never lasted more than three or four months. The new belt has operated over eleven months.

Another neoprene development is a line of gaskets now available from the Victor Manufacturing & Gasket Co., Detroit, Mich. The gaskets embody asbestos and neoprene, but are produced by a novel and unique process and are not supplied in sheet form. In making a gasket it is first blanked from asbestos sheet material, after which it is coated with a special neoprene cement. Two types are produced, an uncompressed type for lighter flange pressures, and a compressed gasket for heavier flange pressures. Decidedly superior results as compared with other gasket materials have been reported for the new gaskets at high temperatures under exposure to such materials as water, oils, glycerine, ethylene glycol and methanol.

ANNOUNCEMENT has been made by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, of a new series of Tramrail Arch Beams for overhead materials handling systems loaded up to 5 tons. This beam is composed of a wide-flange T-member to which is welded a specially rolled rail. The vertical web member is arched at intervals to reduce weight without loss of strength. Three sizes are included in the new series, having weights from 28 to 50 lb. per foot, and depths from 12 to 15 in. Important features include unusual lateral stiffness, and a special high-carbon rail providing great strength and a hard, flat running surface for the monorail carrier.

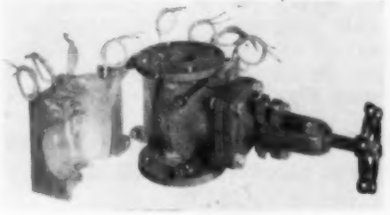
## Valve Heating Element

A SIMPLE DESIGN of heating device for valves has been announced by Harold E. Trent Co., 55th St. and Wyalusing Ave., Philadelphia, Pa. The accompanying illustration shows a 2-in. valve equipped with such a heater. The heating elements are assembled into holes in a cast metal body which is in halves, and the halves are then bolted together around the valve. This construction is said to result in high efficiency compared with winding a resistance wire or tubular heating element around the valve. The construction also makes it easy to remove the heater without danger in the event of repairs being made to the valve. Other variations of this arrangement are also available to meet special requirements.

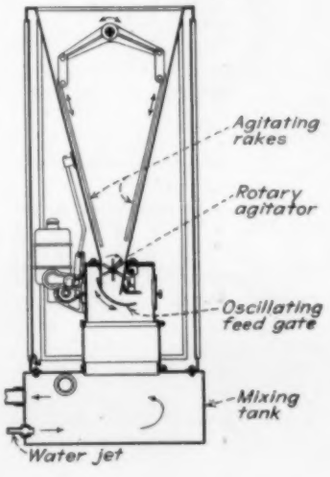
## Dry Chemical Feeder

AN IMPROVED FEEDER for dry chemicals, recently announced by the Permutit Co., 330 West 42d St., New York, N. Y., features agitating rakes at the sides of the hopper and an oscillating feed plate, a construction said to assure accurate feeding under all circumstances. The length of stroke of the feed plate determines the rate of feed. Simple means is provided for varying this stroke during operation to any position within the range of the feeder. A tank placed beneath the feeder provides 10 minutes detention time for dissolving the chemical. The feeder is adaptable either to constant or proportional feeding, the latter being possible through the use of some form of meter which actuates the feeder for a definite period at the end of each predetermined increment of flow.

**Electrical valve heating element**



**Dry chemical feeder**



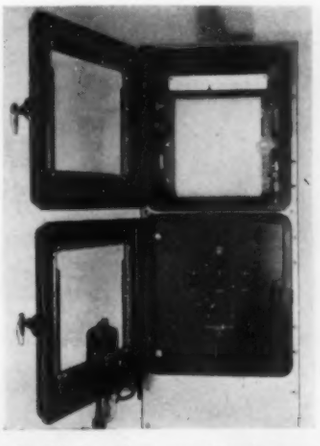

## Midget Pumps

EASTERN ENGINEERING CO., 45 Fox St., New Haven, Conn., has announced two new midget centrifugal pumps designated Models D and E. Model D, which weighs 14 lb. and employs a continuous-duty, fan-cooled, split, capacitor-type motor, close-coupled to the pump impeller, is rated at 17 lb. per sq.in. maximum pressure and 5 gal. per min. maximum capacity. It may be used in the presence of fire and explosion hazards. Model E, employing a 1/20th hp. universal fan-cooled motor, and weighing 6 lb., is rated at 20-25 lb. per sq.in. maximum pressure and 8 gal. per min. maximum volume. Both types are available in stainless steel, Monel metal and chromium-plated bronze, and both may be obtained specially in other metals and alloys.

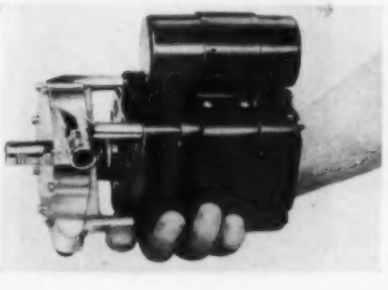
## Hydrogen-Ion Equipment

TWO RECENT DEVELOPMENTS of Cambridge Instrument Co., Grand Central Terminal, New York, N. Y., include the new Electron-ray pH meter and a thermionic pH recorder. The meter, which is of the industrial type with electrodes contained in a space within the meter cabinet, features the use of a cathode-ray tube having a variable-width beam on a fluorescent screen, which is used for balancing the po-

**Cambridge potentiometer-recorder**



**Model D midget centrifugal pump**



tentiometric circuit instead of a galvanometer. Another feature is a glass electrode of the silver-silver chloride type, built on the "condenser" system in which a considerable area of glass membrane is exposed on the inside to the test solution and on the outside to the electrode HCl. Cleaning of the glass electrode can be accomplished readily with a pipe cleaner.

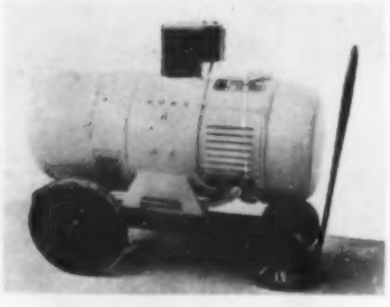
The new recorder comprises two units, the electrode assembly and the combined thermionic potentiometer-recorder. Automatic balancing of the potentiometer is accomplished by thermionic means. Line operation from a standard 110-125 volt a.c. circuit eliminates use of batteries. The continuous-flow electrode is of the glass electrode type, employing a saturated-calomel reference electrode making junction with the test sample through a ground glass plug. A resistance thermometer incorporated in the flow chamber provides automatic temperature compensation. A weather-proof housing permits installation out of doors if desired.

## Arc Welder Improvements

A NEW DEVICE for remote control of its Hornet arc welders has been announced by Wilson Welder & Metals Co., 60 East 42d St., New York, N. Y. To utilize the new device, the handwheel governing the control pole of the standard welder is replaced by the new reversible motor-driven type SC remote control device. Adjustments to the current output are made by the operator, merely by touching one of two contacts on the electrode holder to the ground. One contact increases, the other decreases the welder output. Limit switches and a slip clutch prevent damage to the control motor when the end of the range is reached.

A second recent improvement for its Hornet welders is a new automatic start and stop device announced by the company. The operator starts the welding unit simply by touching the work with his electrode holder. The unit continues running as long as welding is in progress, but when it is interrupted, the machine automatically stops after a time delay which may be set at between ½ and 1½ minutes to suit the conditions of the job at hand.

Remote-controlled arc welder



Redesigned temperature controller

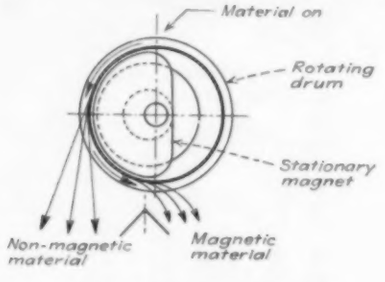
## Improved Instruments

MECHANICAL refinements and restyled cases have been announced for the entire line of indicating, recording and control instruments manufactured by Mason-Neilan Regulator Co., Boston, Mass. The improvements include such features as a new, more compact and more rapid amplifying pilot valve; re-arrangement of control assemblies to permit removal of all working parts as a unit; and refinements of the case, chart plate and gage dials.

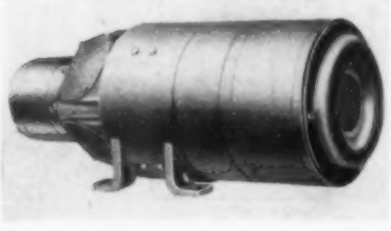
## Magnetic Equipment

NEW MAGNETIC EQUIPMENT of several types has been announced by the Magnetic Engineering & Mfg. Co., Clifton, N. J. Included are magnetic pulleys; complete magnetic pulley-type separators comprising magnetic pulley, idler pulley, belt, framework and drive; spout magnets; magnetic filters for slips and slurries; suspended magnets; and magnetic drum separators. The newly designed magnetic pulleys are said to feature greater power, uniform flux distribution, ease of repair and longer life. The magnetic filter, which is of rust-proof material, employs a screen assembly which may be cleaned by lifting out and washing, or by flushing through a cleanout opening. The filter has a top discharge as well as a top feed, to eliminate the necessity for a float valve.

Diagram of drum-type magnetic separator




Typical speed variator M. G. set



Chem & Met Pictured Flow Sheet

The magnetic drum separator consists of a powerful stationary magnet around which a cylinder revolves. Material to be separated is fed on to the top of the cylinder, the non-magnetic material discharging from the cylinder unaffected, while the magnetic material is carried around to the underside until it passes out of the magnetic field and is discharged.

## Speed Variator

TO PROVIDE variable speed over a wide range through the use of all-electric, alternating-current equipment, the General Electric Co., Schenectady, N. Y., has recently announced a complete speed-variator unit, comprising an adjustable-speed direct-current motor, an adjustable-voltage motor-generator set with control, and a separately mounted generator-field rheostat. Standard speed ranges are available up to 16 to 1 ratio. The motor may be mounted directly on the driven machine, with the speed-changing control mounted nearby. Units are designed to operate from three-phase current of 220, 440 or 550 volts. The potentiometer-type generator-field rheostat provides speed changes in small increments over a wide range. Suggested applications include use with textile, paper and other processing machinery and on pumps and fans.

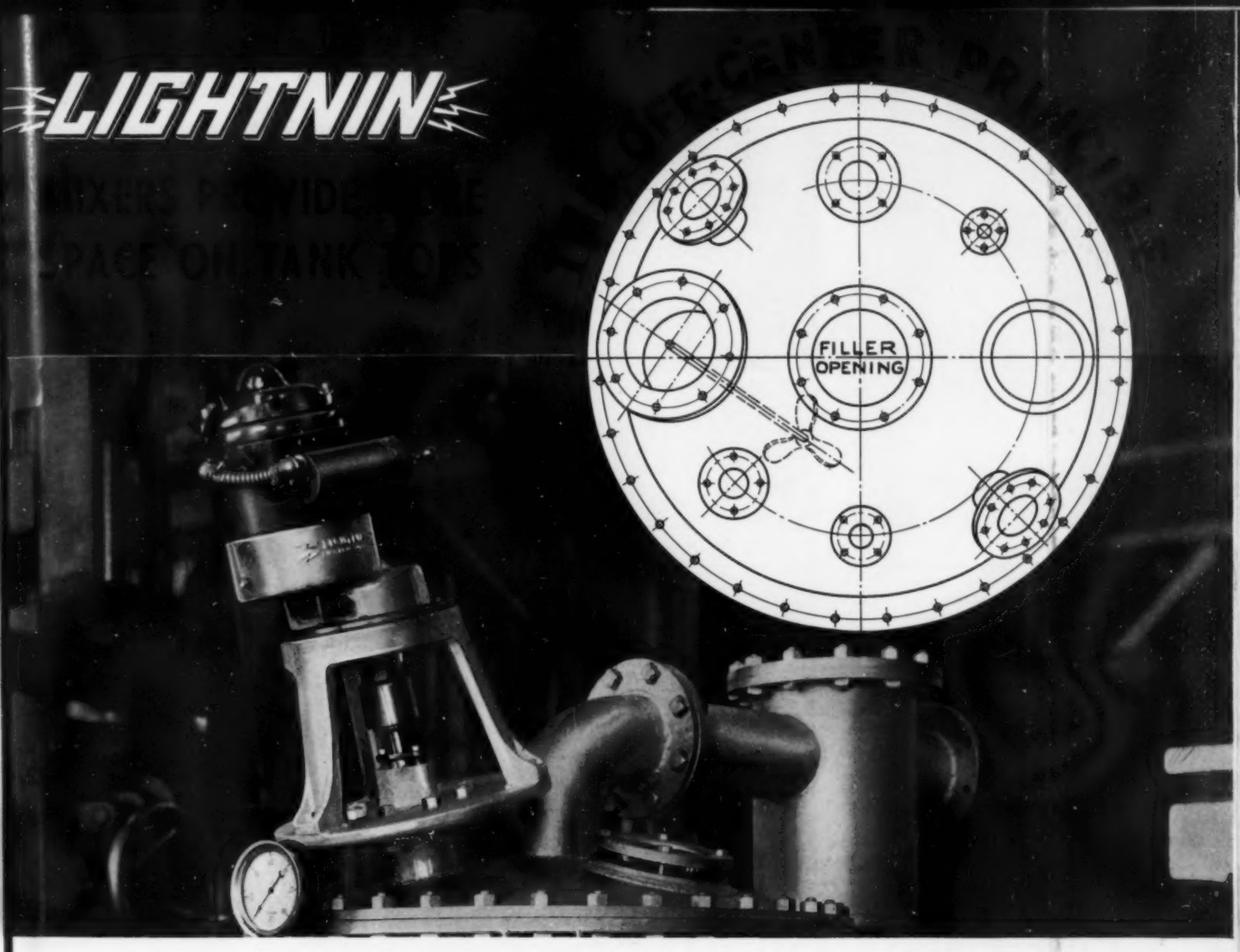
## Equipment Briefs

WIDE VISION in all directions is claimed by the manufacturer for a new mask of fully molded rubber announced by the Davis Emergency Equipment Co., 55 Van Dam St., New York, N. Y. This mask, which is supplied with both hose mask units and canisters, employs flat, shatter-proof glass lenses set to avoid reflection. Perfect fit to all sizes and shapes of face is said to be secured with minimum head-strap tension. The small dead air space is claimed to minimize rebreathing, thus lessening the tiring effect of wearing the mask for long periods.

A NEW DEVELOPMENT of Greene, Tweed & Co., 101 Park Ave., New York, N. Y., is Palmetto compressed asbestos sheet packing, a product which is stated to be the result of several years of research. Made of

(*Please turn to page 663*)

LIGHTNIN




# CLEARED FOR ACTION

This plan of a tank head is taken from our files of actual installations. Note how the mixer off the side gives more room and better arrangement than would be possible with right angled gear reductions and centerline installation. Give your designers a real chance at usable heads with easy location of manholes, flanged openings, observation glass, vapor outlets, thermometer wells, etc., at the most advantageous places. Contrast this with turbine, paddle or anchor type agitators which are located in the center—making it necessary to locate all openings around the rim.

No space-consuming drive supports are necessary. When mounted on a flanged nozzle or manhole, the drive and supports occupy the minimum of space.

Plan on using these mixers in your new plant expansion and assure yourself of trouble-free agitation.

Complete range of types and sizes of motors and materials. Other types of "LIGHTNIN" Mixers and mounting methods described in the literature—check the coupon.

## MIXING EQUIPMENT COMPANY, Inc.

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**Mixing Equipment Company, Inc.**
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Please send me:

.....Catalog B-68—Top Entering Mixers
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.....Catalog B-65—Portable Mixers
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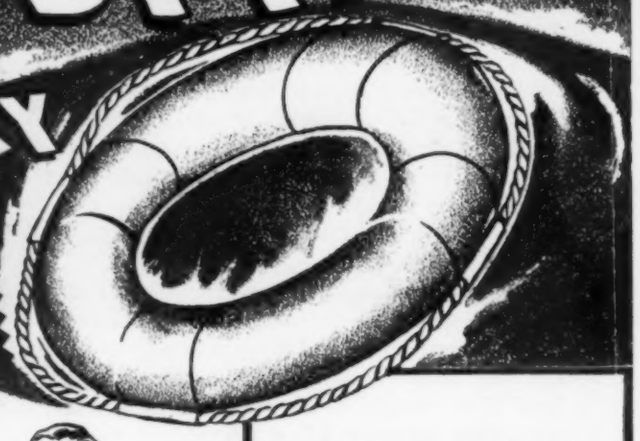
# RESCUED WITH A BY-PASS

## A CASE STORY

**SOLVED WITH PREVENTIVE MAINTENANCE**



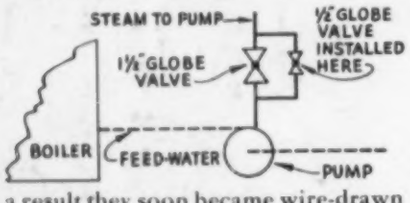
"Man alive"—shouted the SUPERINTENDENT—"we just replaced that valve a short time ago!"

"But we can't let the pump run wild"—the PLANT ENGINEER tried to explain.

"Sure enough"—said the CRANE MAN—"but Preventive Maintenance will stop the source of trouble."

AN eastern plant was having endless trouble with a valve on the boiler feed pump. It was a steam-driven pump—controlled with a 1½-inch globe valve.

Under peak loads or in an emergency, this valve was ideal. But for normal feed-water needs it was much too large. Most of the time the steam was throttled so close that the disc and seat were barely "cracked." As




a result they soon became wire-drawn and the valve began to leak—a dangerous and wasteful condition.

Pulling the fire to make valve repairs was costly. A permanent remedy for the trouble had to be found. "Here is a case for Preventive Maintenance," said the Superintendent as he called in D. N. G., the Crane Man, on the problem.

Preventive Maintenance counseled the installation of a ½-inch globe valve in a by-pass line around the present valve. With the large valve closed tight, the ½-inch valve, when fully open, would assure ample steam for normal pump operation. For emergency loads, the 1½-inch valve would be available—but rescued from severe throttling service.

**Results: (1) The trouble was eliminated—permanently, easily. (2) Again Preventive Maintenance paid for itself many times over. (3) Another management knows that it can rely on Crane for sound advice and the right valves and fittings to solve every piping problem. Knows, too, that it's best to call the Crane Representative whether the trouble is big or little.**

*This case is based on an actual experience of a Crane Representative in our Syracuse Branch.*

## FINE FLOW CONTROL WITH CRANE BRASS PLUG DISC VALVES

In any service—steam, water, oil, gas—where valves must operate in partly open position or are frequently opened and closed, in every way these valves will give better performance than you would expect.

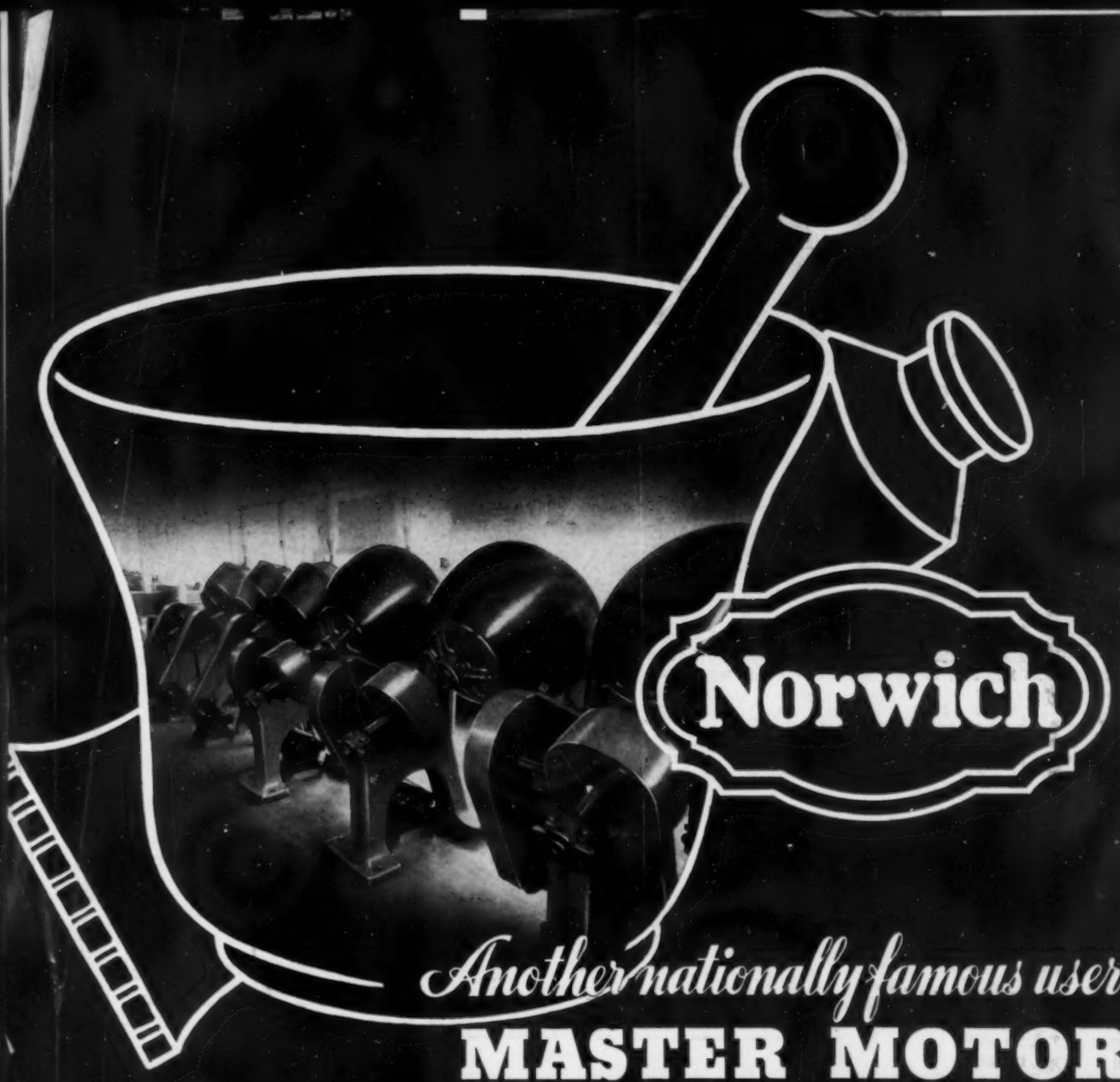
Crane plug-type disc construction assures accurate and easy regulation of flow, and a longer life of positive tightness. The wide seating surface and the perfect combination of alloys in the tapered disc and seat give unusual resistance to the damage of foreign matter and wire-drawing, to wear and galling. A sturdy brass body and careful engineering in every part make these valves extra fit for the toughest jobs.

Crane Brass Plug Disc Valves are the popular choice for Preventive Maintenance on sootblower, blow-off, boiler feed, drip and drain lines. They're made for pressures up to 350 pounds at 550°. For 150 pound lines, specify No. 14½P.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

*VALVES • FITTINGS • PIPE*
*PLUMBING • HEATING • PUMPS*




*Another nationally famous user of*

# MASTER MOTORS

**NORWICH Pharmaceuticals (Ungentine, Pepto Bismol, Amolin, etc.) must be made from the best of materials and with the finest equipment to maintain their leadership in their field. NORWICH engineers have found that Master Motors built to meet the individual requirements of each job, add greatly to the compactness, economy, safety and convenience of their equipment.**

**You, too, may secure these advantages. Investigate MASTER'S unusual ability to serve you promptly and economically, with motors that really fit YOUR needs.**

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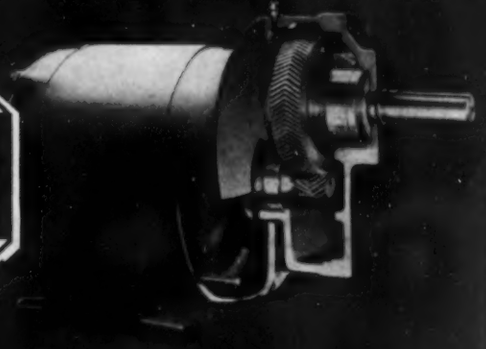
**MASTER**



# TRIPLE PROOF

## ON HOW TO SAVE PRODUCTION DOLLARS WITH ALLIS-CHALMERS LO-MAINTENANCE MOTORS!

**Read These True Stories for the Inside Facts on Why Allis-Chalmers Lo-Maintenance Motors are First Choice with Men Who Want Record-Breaking Motor Performance!**

WHEN THE GOING gets tough and profits depend on performance — that's when you need Lo-Maintenance Motors more than ever!

For, don't forget — Allis-Chalmers Lo-Maintenance Motors are built to operate under the most severe conditions.

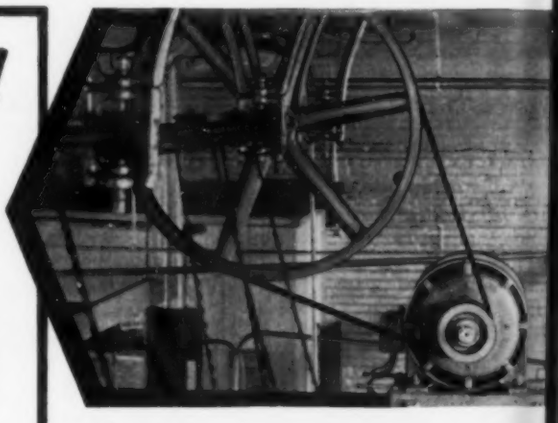
High carbon steel frame... indestructible rotor . . . Distortionless stator . . . no skimp or stint in materials and workmanship— all these are real reasons why Lo-Maintenance Motors hold an industry-wide reputation for standing up under conditions that many times wreck ordinary motors.

Get the complete Lo-Maintenance story. Call the engineer in the district office near you . . . or write Allis-Chalmers, Milwaukee.

A 1280

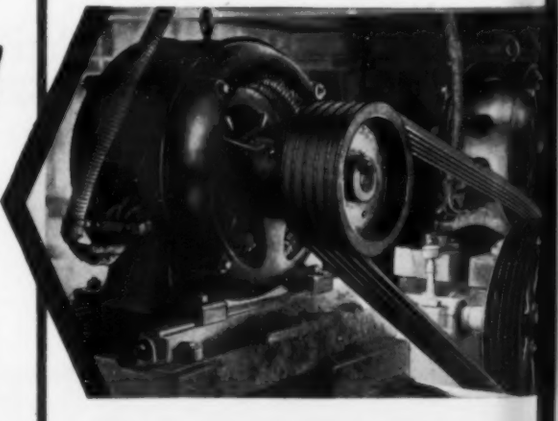
### NINE YEARS IN A DYE HOUSE!

ORDINARY MOTORS WERE cracking up in 12 to 14 months in the dye house of the Wilkes Hosiery Mills Co. Then they installed an Allis-Chalmers Lo-Maintenance Motor that made news! After nine years of service . . . that Lo-Maintenance Motor was running as perfectly as the day it was installed!



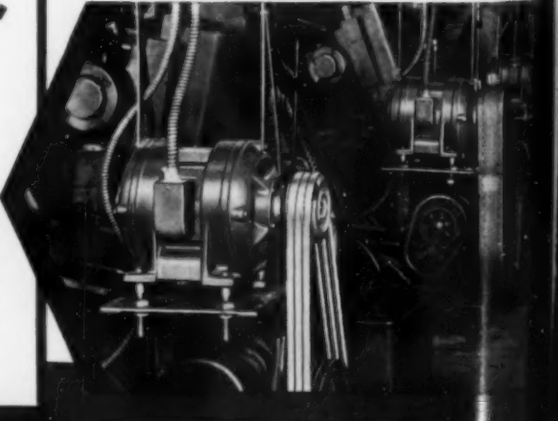
### 29 YEARS ON THE ROCKPILE!

TURNING ROCK CRUSHERS . . . with highly abrasive lime dust filling the air — these two 50 hp Lo-Maintenance Motors have been going 29 years without running up high repair or maintenance expenses for the Waukesha Lime & Stone Co.



### "WE'LL TAKE A CARLOAD!"

WHEN THE WARNER AUTOmotive Parts Division of Borg-Warner needed motors for a new plant, they checked motor operation in their other plants . . . found Lo-Maintenance led in performance and low cost. That's why they ordered a carload — 346 at one time!



*Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!*

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H
S!

# CHEMICA
# STONEWA

CHEMICAL STONEWARE has interest to the chemical engineer. by chemical processing and in turn pl portant part in the making of othe products. One of the large manufa stoneware, porcelain and other cerami for industrial uses is the General Ce with several plants in the neighborhoo Amboy, New Jersey.

The process of making stoneware preparing the plastic material, shaping desired forms, drying and firing, and The raw materials are crushed, scr freed of iron particles. The clays and mixed in a blunger and then filtered which removes part of the water and able portion of the soluble salts that tionable. The filter press cakes, tog necessary non-plastic additions are brought to the desired moisture conte mill. This material is then extruded in cool, moist vaults for at least Aging of the mass is necessary in o velop maximum plasticity and unifor content throughout.

The plastic material is formed int shapes by one or a combination of se ations, extruding, jiggering, hand pre ing and dry pressing. The forms are then set in large rectangular, down- burning kilns in which they are fired. fied ware is machined with high-sp carbide grinding wheels or drilled with silicon carbide grain and cut wi impregnated metal blades.

The accompanying diagrammatic a flowsheets illustrate the process of ma cal stoneware in the No. 1 plant of Ceramics Co. at Keasbey, N. J.

Chem & Met

# ICAL
# WARE

EWARE has a two-fold
ical engineer. It is made
nd in turn plays an im-
king of other chemical
large manufacturers of
other ceramic products
e General Ceramics Co.
e neighborhood of Perth

g stoneware consists of
terial, shaping it into the
d firing, and machining.
crushed, screened and
The clays and fluxes are
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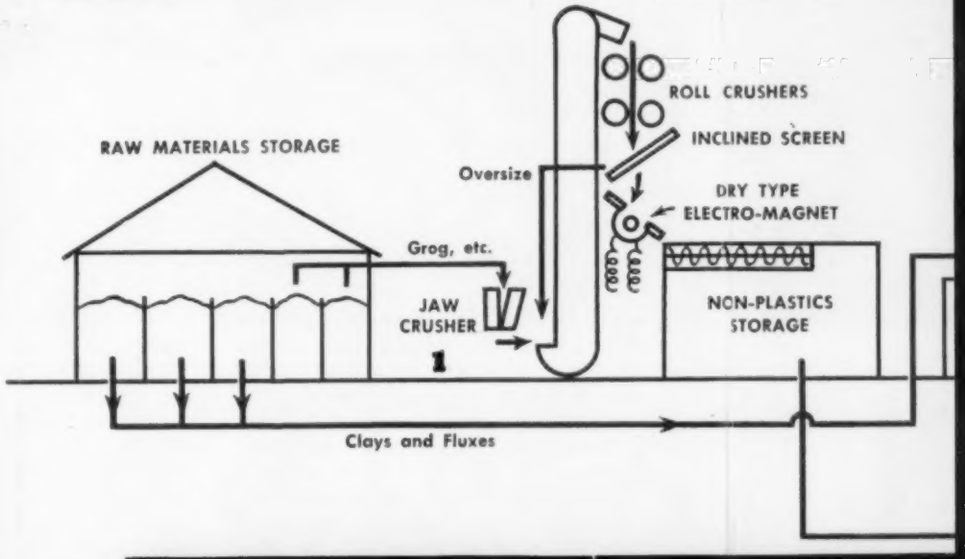
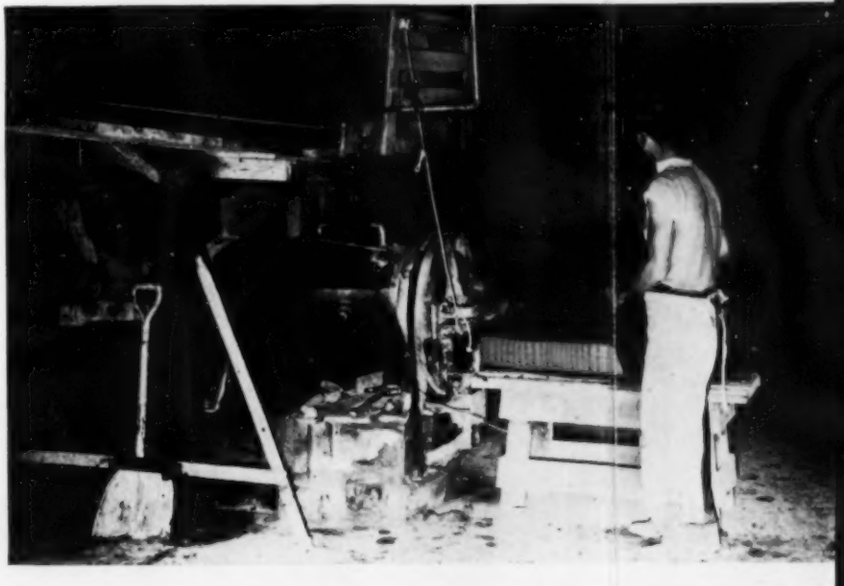
**1.** Grog and other non-plastic raw materials are given a preliminary crushing in a jaw crusher, after which further size reduction is accomplished by means of a series of rolls. The crushed material is screened and passed through a magnetic separator to remove abraded iron

**2.** After thorough mixing of t in the blunger, the resulting su and passed through a magn separator shown is of the hig effectively removes many iron-b well as metallic iron



**4.** Filter press cakes, together with necessary non-plastic additions, are thoroughly mi and brought to the correct moisture content in a pug mill. The mixed material is extru in a solid column and cut into lumps of convenient size for handling and storage

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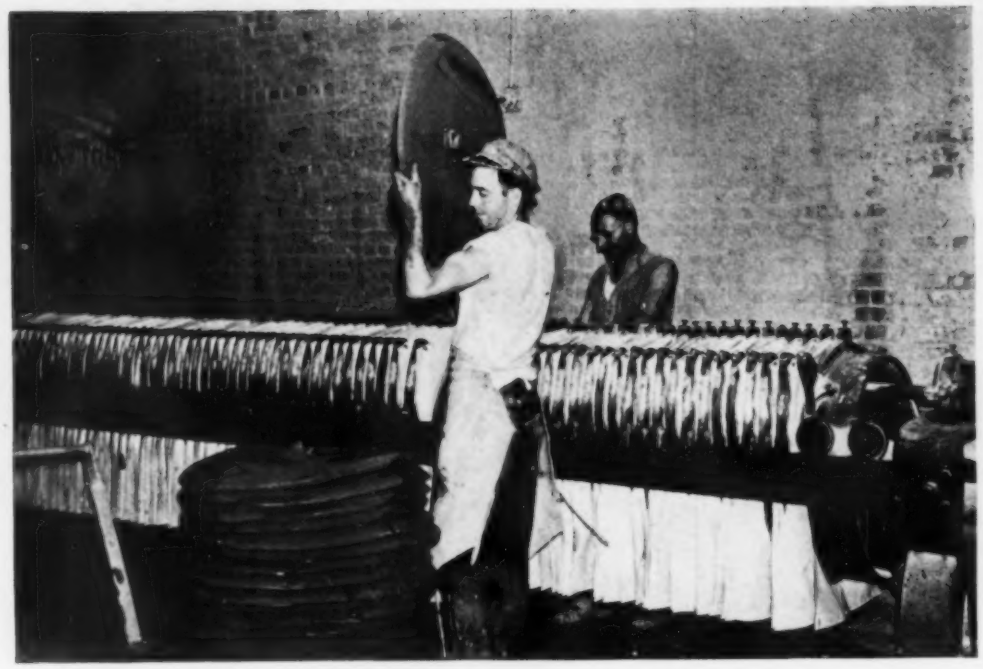
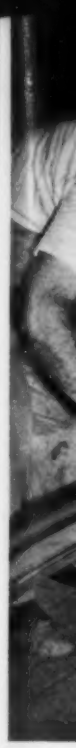
**2.** After thorough mixing of the clays and fluxes in the blunger, the resulting suspension is screened and passed through a magnetic separator. The separator shown is of the high-intensity type, and effectively removes many iron-bearing minerals, as well as metallic iron



**3.** Part of the water is removed from the clay slip in filter presses. Filtering also removes a considerable portion of the soluble salts found in all raw clays. These salts are objectionable if present in excessive amounts



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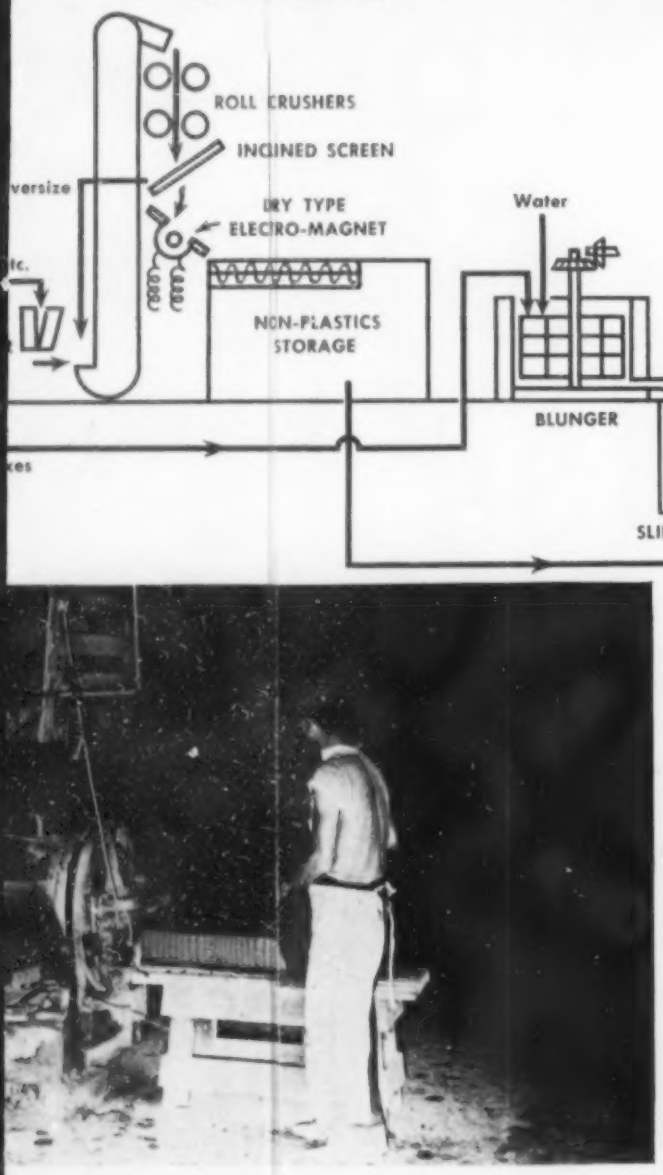
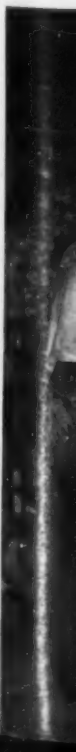





n necessary non-plastic additions, are thoroughly mixed
content in a pug mill. The mixed material is extruded
ps of convenient size for handling and storage

**5.** Prepared material is stored in cool, moist vaults for at least two weeks, or until required. Storage aids in developing maximum plasticity and uniformity of moisture content throughout the mass



**9.** Jig
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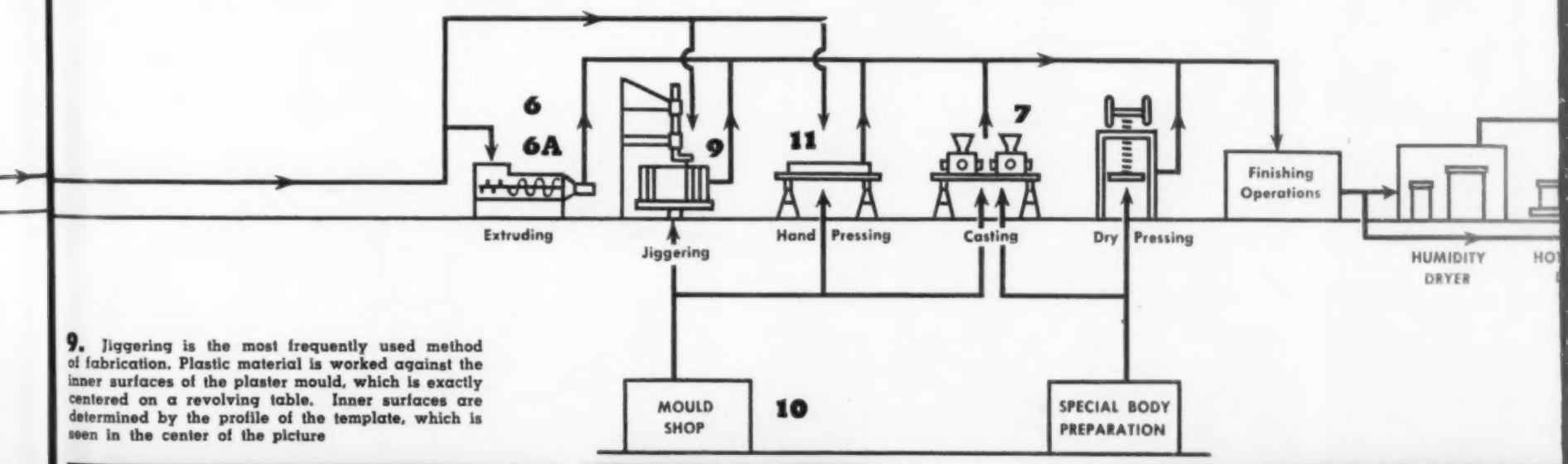
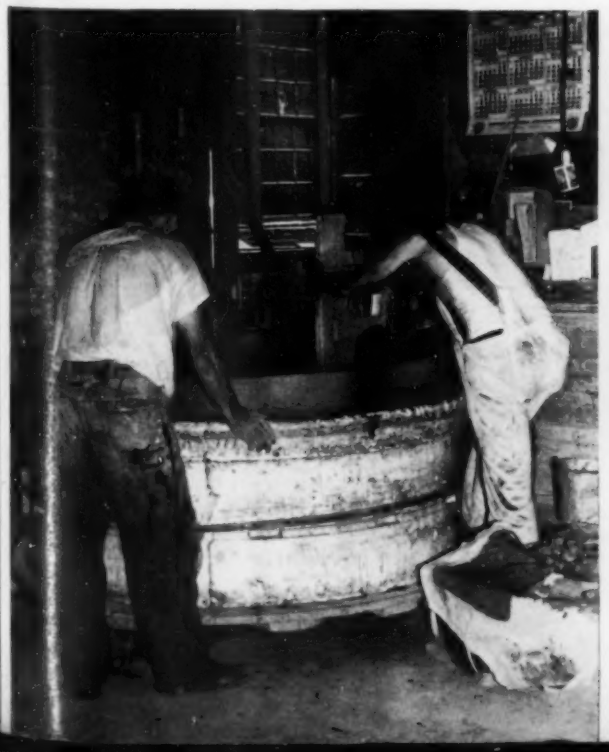
**6.** Horizontal extrusion presses of the vacuum type are used for extruding tubing and other shapes up to about 6 in. diameter

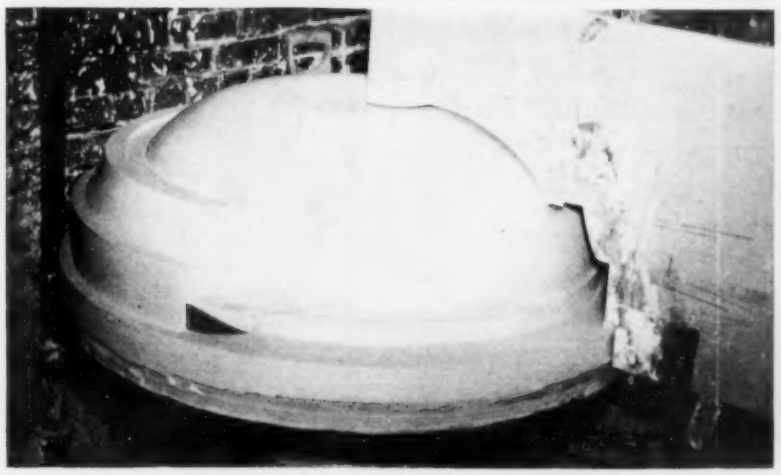
**6A.** Extruding is accomplished by forcing the plastic body through a die having the desired cross section. Both vertical and horizontal extrusion presses are used. The press pictured is a large vertical type extending through three floors

**7.** Casting is accomplished by filling the plaster moulds w The funnels act as reservoirs to keep the moulds filled as the w by the plaster. Casting time varies from about 15 minutes to 20 depending on the thickness of the cast sections




**9.** Jiggering is the most frequently used method of fabrication. Plastic material is worked against the inner surfaces of the plaster mould, which is exactly centered on a revolving table. Inner surfaces are determined by the profile of the template, which is seen in the center of the picture





**10.** Since a large proportion of ware is fabricated in plaster moulds, the mould shop is an important portion of the plant. Moulds having circular cross sections are made by working gypsum plaster over a suitable pattern on a rotating table

**11.** Shapes which cannot be conveni ployed are hand pressed in suitable m required is worked into the mould, and fine wire drawn against guides having

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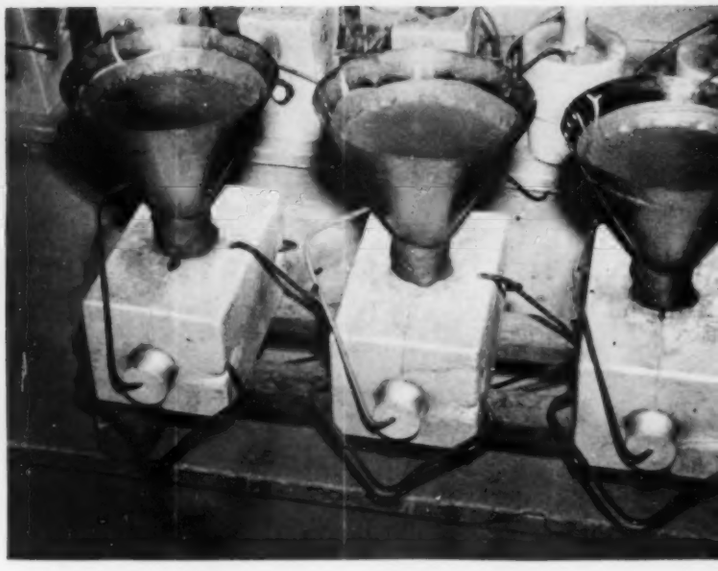
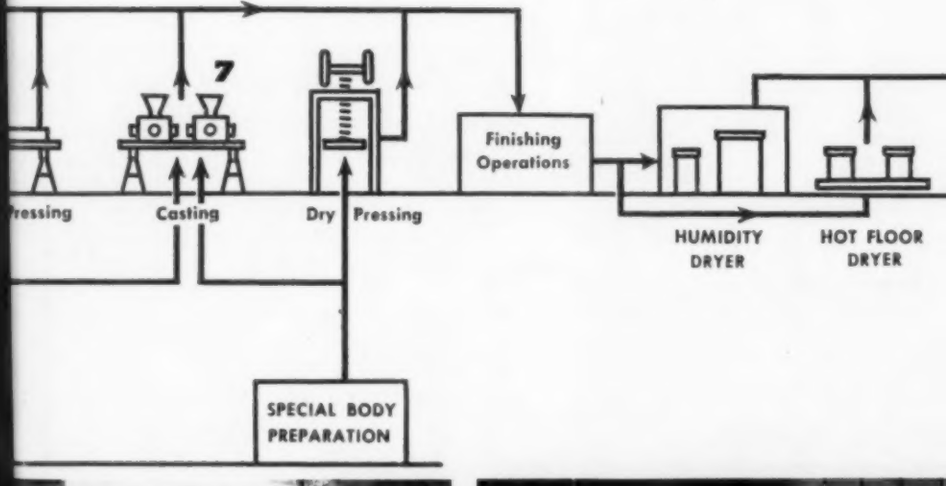


**7.** Casting is accomplished by filling the plaster moulds with a fluid
The funnels act as reservoirs to keep the moulds filled as the water is abs
by the plaster. Casting time varies from about 15 minutes to 20 hours or
depending on the thickness of the cast sections



ware is fabricated in plaster moulds.
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**11.** Shapes which cannot be conveniently mou
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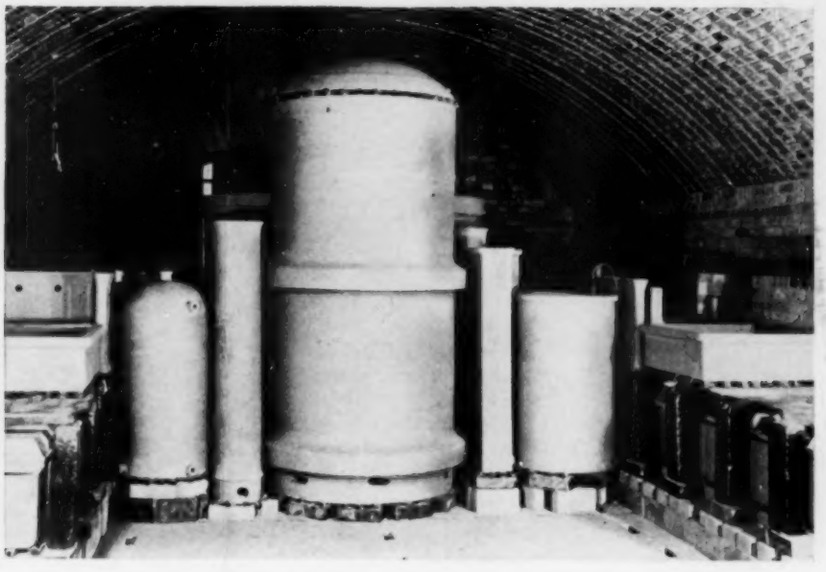
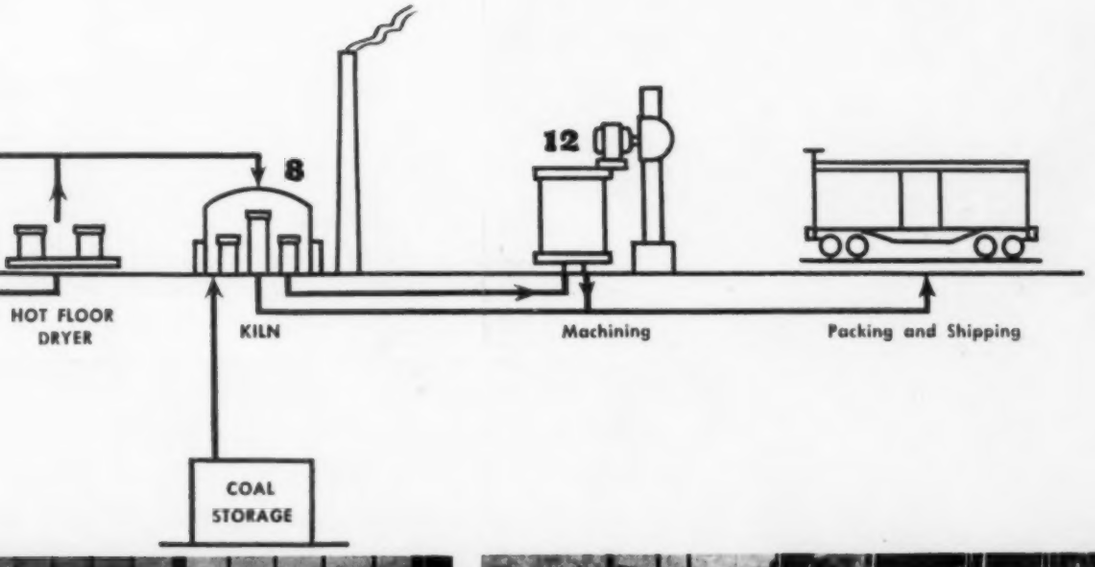
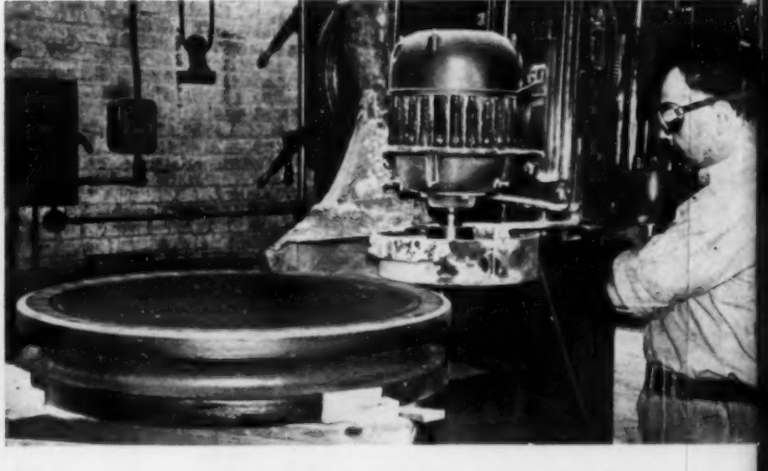


**8.** The dried ware is set in large rectangular, down-draft, coal-fired, kilns. Fire boxes are located behind the baffles shown at the right in the picture. The hot gases travel down through the ware and out the ports in the floor



nveniently moulded by the other methods em-
ble moulds. Slightly greater thickness than is
and the excess is removed by cutting with a
ving the desired profile



**12.** Fired ware is machined with high-speed, silicon carbide, grinding wheels. Other methods employed are drilling and lapping with silicon carbide grain, and cutting with diamond impregnated metal blades

# Technical, Industrial, Personal

Chem & Met NEWS

### SCIENTIFIC AND SPECIALIZED PERSONNEL INDEX

Uncle Sam has embarked on the job of cataloging the scientific and specialized brainpower of the nation in a giant card index file. Called the National Roster of Scientific and Specialized Personnel, the card file is the joint undertaking of the National Resources Planning Board and the Civil Service Commission.

The undertaking is similar to that made by the Royal Society in Great Britain last year. At first, membership lists of scientific and professional organizations will be used to mail two questionnaires to those to be indexed. One questionnaire, general in nature, will record data on address, age, sex, training, etc. The other, varying for specific fields, will cover in detail the individual's range in his field of practice and any technical hobby which he follows.

So far, the problem of cataloging individuals who are not members of specialized organizations has not been cracked. Not yet, at least, should such persons apply for questionnaires, but this invitation probably will follow the first culling. Use of such master lists as those of the University of Chicago also are expected to help complete the roster.

The roster is under the direct supervision of Dr. Leonard Carmichael, president of Tufts College, and James C. O'Brien of the Civil Service Commission, the latter serving as executive officer. Committees of technical experts will be named as the job goes forward, to evaluate certain lists of names for specific jobs and to protect the continuance of important work in progress in the nation's laboratories.

Dr. John S. Nicholas will represent the National Research Council on the National Roster Committee and will serve as Executive Secretary of an Evaluation Committee in the field of Engineering. This committee will consist of Acting Chairman, Dr. H. A. Poillon, Dr. Maurice Holland, Dr. F. G. Cottrell, Dr. F. M. Feiker, Dr. Webster N. Jones and Stephen L. Tyler.

### NEW CHEMICAL PLANT PROJECTS IN VARIOUS SECTIONS

Following the announcement last month, that the Monsanto Chemical Co. would build a new plant for the manufacture of phosphates at Trenton in the Detroit area, comes the report that the General Chemical Co. already has broken ground for a plant for the manufacture of heavy chemicals in the same section. Reports from the Niagara Falls area state that Mathieson Alkali Works will make important plant extensions and that E. I. du Pont de Nemours & Co. will build a new research laboratory. The Hercules Powder Co. will build a new $1,000,000 plant at Parlin, N. J., which it will operate for the New Jersey Powder Co. And from the far west comes the report that the Pennsylvania Salt Mfg. Co. is negotiating with the Bonneville Power Authority for power to operate a new plant for the manufacture of chlorate of soda.

### COCONUT OIL MILL PLANNED FOR VANCOUVER

Establishment of a $200,000 copra pressing plant in Vancouver, B. C., will be undertaken immediately according to information received by the British Columbia Department of Trade and Industry. The plant will be the only one of its kind in Canada.

A company known as W. R. Carpenter (Canada) Ltd. has been formed to direct the operation which will give work to between 30 and 40 men. Directors of the firm are Sir Walter Carpenter, R. O. Campney, E. F. Riddell, E. E. Buckerfield (Vancouver) and John Raymond, of San Francisco. According to present plans, the department said, the plant will have a capacity of 1500 tons of copra per month, producing roughly 900 tons of coconut oil and 600 tons of copra meal. Arrangements have been made for eastern soap manufacturers to take the whole output of coconut oil.

### ELECTRO MANGANESE CORP. OFFERS CASH RESEARCH PRIZES

The Electro Manganese Corp. of Milwaukee is renewing the offer made last year whereby cash prizes are made available in the sum of $300, $200, and $100 respectively to undergraduate and graduate students who submit the best papers presenting original fundamental research work on electromanganese. Such work may be in the fields of metallurgy and metallography, chemistry, or physics. All papers must be submitted to the Electro Manganese Corp. in duplicate by July 1, 1941. Winners of the contest announced last year have not yet been chosen as the time limit does not expire until Sept. 20.

### NEW CHEMURGIC CORPORATION FORMED IN TEXAS

A new $500,000 chemurgic corporation has been formed at Dallas, Texas. Plans of the new company, known as the Texas Chemurgic Industries, Inc., call for a series of chemurgic enterprises starting with the manufacture of a dehydrated sweet potato stock feed and byproducts in the first unit to be erected on a site in east Texas and to be in operation for this year's yam crop. This unit will have a daily capacity sufficient to handle 100 to 150 tons of sweet potatoes and will cost between $20,000 and $30,000. Later, other plants will be located at strategic centers. William C. Witt is president of the corporation, Gilbert C. Wilson of North Texas State Teachers College is vice-president and technical director, Logan Ford is vice-president and general counsel, and R. B. Hinks is secretary and treasurer.

### A. R. MAAS CHEMICAL CO. STARTS PHOSPHORIC ACID PLANT

Direct production of phosphoric acid from phosphorus was begun on July 29 in the new plant of the A. R. Maas Chemical Co. at Los Angeles. It is the first plant of its kind west of the Mississippi Valley as other producers of this acid depend upon the sulphuric acid method. In addition to being able to supply requirements of high grade phosphoric acid in the Pacific Coast area, a good part of the output will be used for the manufacture of sodium pyrophosphate, trisodium phosphate and other phosphates of soda. The Maas company pioneered in the production of phosphates of soda in California, starting with trisodium phosphate in 1928. Before that it was the first firm in the west to make sodium sulphite and sodium hyposulphite.

### SPRAY RESIDUE TOLERANCES REVISED UPWARD

The permissible quantities of lead and arsenic on apples and pears shipped under the jurisdiction of the federal food law were doubled by an official advisory opinion released August 12 by Administrator Paul V. McNutt. From now on apples and pears may carry up to 0.05 grain of lead per pound and 0.025 grain of arsenic ($As_2O_3$) per pound.

These increased allowances apply only to these two specific fruits. They are not general in application. Nor have any changes been authorized in the tolerance for fluorine which remains at 0.02 grain of F per pound for these fruits and for other commodities.

Chem & Met Pictured Flow Sheet

# News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

CONFERENCES during August have much encouraged the chemical and rubber divisions of the Defense Commission with respect to prospects for expansion. It appears that the capacity for manufacture of synthetic rubber in the United States is likely to reach 10,000 to 12,000 tons per year well before the end of 1940. The industry contemplated doubling this capacity next year. But the Defense Commission would like a very much larger multiplier used.

Exact commitments have not been made by individual companies as yet. Tentative assurances given are generous. In the aggregate these will probably work out into a much accelerated total program. Exact estimates are, of course, confidential not only for individual companies but for the project as a whole.

Late in August it appeared that the Government would not have to participate as an owner in any of this plant expansion. Some loans or advances against contracts for product may be made. But the business will be run essentially by the present rubber companies and the chemical companies which will supply the butadiene, butene, styrene, acrylonitrile and other needed chemicals. Several of the big petroleum companies are participating both in the making of these chemicals and in some parts of rubber synthesis. A larger number are makers of chemicals only. It is expected that during October some rather definite contracts will be made with the Government. It is likely that these will take the form of purchase of the products of synthetic manufacture by Rubber Reserve Co., the quasi-government corporation sponsored by R.F.C. The synthetic product will, of course, be used extensively for tire making, the matter of greatest concern to the Army. Special applications of the synthetic product by the industry will also be encouraged, but the prime object of the defense program is to get rubber of synthetic origin and learn how to use it for the major rubber product of the country, tires.

### Defense Buying

Purchases and contracts for procurement of commodities manufactured by chemical process industry have been going forward aggressively during the last few weeks. Conspicuous progress has been made with respect to important needed minerals and metals. In most cases the progress has been by contracts for the Government to purchase the product from new developments being made by private industry.

Aluminum production is being rapidly stepped up. Several new plants of Aluminum Co. of America are under construction. A loan has also been arranged for Reynolds Metal Co. with which it plans to build a primary reduction plant at Fairfield, Alabama. The sources of bauxite and pure alumina have not been announced. Power will be furnished by TVA. The R.F.C. loan is for $15,800,000.

Several manganese contracts have been closed. Anaconda Copper Mining Co. will supply 80,000 tons per year of manganese concentrate manufactured at its Emma mine near Butte, Montana. Cuban-American Manganese Corp. has agreed to enlarge its plant capacity near Santiago, Cuba, by one-third to permit more rapid preparation of ferro-grade manganese ores. Several other contracts for domestic supplies are being negotiated and announcement of these was expected during September. Financial assistance is also being given to the Brazilian transportation agency which brings high-grade manganese ore to the coast of that country. Numerous contracts for purchases of foreign ore are being arranged.

Tin is being bought in large quantities as fast as the Dutch are able to bring it from the Far East. The government purchasing agency is Metals Reserve Co., a subsidiary of R.F.C. Negotiations are also in progress from which it is hoped that one or more domestic tin smeltering enterprises may develop. One of these may be specially planned to smelt Bolivian ore. There is some chance that Dutch interests will also establish an American smelter to process tin concentrates in this country, supplementing their smelters in the Far East.

Rubber purchasing by both industry and the quasi-government corporation continues to enlarge the stocks held in the United States. The only limitation on the rate at which the government will stimulate this development is the transport limitation from the Orient.

Aviation gasoline supplies are to be built up by a new government company financed by R.F.C. It will have a $5,000,000 capital stock issue, held by the government. It initially has a loan from R.F.C. of $50,000,000 with which to buy and store the desired 100-octane aviation gasoline. One of the new aspects of this program is the plan to build underground concrete tanks, lined with light sheet metal, as the storage units near the coast.

### Anti-Trust Actions

The Department of Justice was planning during August to initiate suit in the federal courts against a number of petroleum companies. The objective was to separate production and refinery facilities from pipe line, transport, and marketing facilities. This action was deferred briefly so that the Defense Commission might comment on the effect of such action on preparedness plans. The anti-trust proceeding was criticized by many as unreasonable at this time, irrespective of the long-time merit.

Several other anti-trust actions are in progress. The Government is suing various gypsum companies and their officers in an effort to break down the monopoly which the government charges is based on patents. Another case in which patents may be the issue is one being worked up on magnesium metal. Also Assistant Attorney General Thurman Arnold charges that a number of international patent arrangements are producing illegal monopolistic effect in the United States.

### "Bankable Contracts"

Late in August, the Defense Commission evolved a plan known as the "bankable contract" which is intended to reduce the risk incurred by manufacturers who may be called upon to expand plant facilities in order to take care of government contracts. Under the five-year defense plant tax amortization proposal the cost of plant expansions will be segregated from the cost of the products to be manufactured and will become the subject of a separate contract. The plant contract will provide that the cost be paid in five equal annual instalments. Congress will be asked for legislation which will permit assignment of such contracts so that 100 per cent loans may be negotiated if needed.

At the end of five years, or the end of the emergency, a board of arbitration will be set up with a third man to be appointed by the senior Circuit Court Judge, to determine the then value of the plant, not as a straight appraisal but from the standpoint of its value to the manufacturer. The manufacturer, then may elect to pay the Government the arbitrated price or surrender the plant to the Government for sale elsewhere, for maintenance in standby condition, for demolition, or for other use.

In addition to reducing capital risk on defense plant construction, it is pointed out that this plan may prevent the wholesale demolition of plants after the emergency passes and also will rule out charges that the program has given away plants.

### Munition Plants

Through all the fever heat generated over charges of delays in the defense program, peculiarly overlooked has been the fact that one of the slowest moving phases of the entire effort has been construction of the Army's proposed network of munitions plants, primarily powder for guns. Government financed, Government owned, privately operated under lease on a fee basis, and arguments over amortization or taxes are responsible for the fact that by early September only a small fraction of this plant construction was underway.

There are two reasons for this situation which are apparent, and a third which is not so apparent. First of

these is the fact that more than half the money allocated to this function of defense is in the appropriation bill which went to Congress on July 10 and was kicked around on Capitol Hill for weeks without final action. Dove-tailing into this is the log-rolling inevitably generated by large Government spending—the pushing and pulling of home town elements, aided and abetted by Congressmen, to get the money spent "for us."

These are the explainable reasons. But behind them lies also the fact that great gobs of this munitions plant program was in the theory stage when "total defense" became the prevailing policy. The list of plants disclosed first last June (*Chem and Met, July*) in many respects represented little more than a list; detailed plans weren't ready. One damaging effect of all this is that the "big push" of construction is almost certain to come in winter months when the going will be toughest.

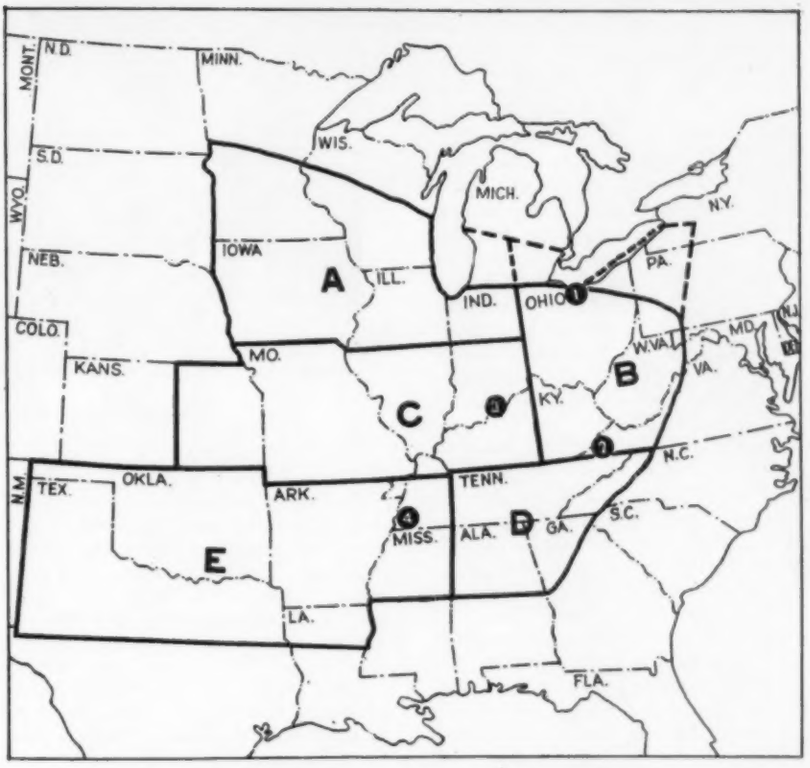
The chemical industry has a big stake in this Army munitions plant program. Of roughly $600,000,000 definitely available, chemicals will take more than a quarter-billion dollars, chiefly for powder, TNT and their components. The table on this page represents the most official compilation of the chemical plants obtainable, brought up to date to include revisions in the original list printed in July resulting from changes in the Army's objectives, together with a "progress chart" showing what has been done to get specific plans out of the drafting room into the field.

Biggest alteration from original list is in TNT plant capacity. Originally only four small plants were contemplated. Increasing use of aerial bombs has brought about a sharp stepping up of this phase of the program; even today's estimates are tentative and subject to upward revision. First TNT plant expected shortly in northern Illinois and first picric acid plant in central Ohio.

West of the Alleghenies, and east of the Rockies is the newly proclaimed guiding policy for locating America's defense plant expansion. Wherever possible, new plant facilities, whether they be Government-built munitions works or private factories turning out defense orders, are being spotted in this "safety belt" area behind the mountain ranges.

The Army has ringed the nation with a "safety zone" 250 miles inland from water and 200 miles inland from land boundaries. Within this area have been set up five munitions districts, and they further contract the territory open for plant "homesteading" to eliminate much of the relatively remote plain states.

Boundaries of these five districts are somewhat unofficial and flexible (see map, this page), but they furnish a rough outline for defense planners assigned the job of getting armament and munitions for the nation's military forces. The Army proposes to so locate its huge assortment of munitions plants that each of these districts can become at least a partially self-sufficient supply and distribution area for men in the field.




**Zones for Location of Government Defense Plants**

**(1) Ammunition loading plant at Ravenna to be operated by Atlas Powder Co. (2) Smokeless powder plant at Radford, to be operated by Hercules Powder Co. (3) Smokeless powder plant at Charlestown to be operated by E. I. du Pont de Nemours & Co. (4) Smokeless powder plant (British Commission) to be operated by E. I. du Pont de Nemours & Co. Areas within dotted lines have unofficial sanction.**

For instance, the first two Army smokeless powder plants were spotted in Southern Indiana and western Virginia, Areas A and B respectively, and the first picric acid and Explosive D plant was scheduled to be set up in central Ohio, roughly equi-distant from each. The entire network of these plants will have this same type of relationship to each other so far as other conditions make feasible.

True, there will be—and already have been—modifications of the original strict lines of this plan. The Canadian rapproachment caused a definite fading of the northern boundary of the "safety belt" and, unofficially anyway, extended the boundaries of the munitions districts (shown by dotted lines on the map) to include such vital centers as Detroit, Cleveland, and Buffalo).

But this growth was largely for armament, rather than strictly munitions plants, as witness the Government-owned Chrysler operated tank factory in Michigan. The guiding principle remains as the key for locating as much of America's defense plan as practicable behind the shielding mountains.

**Munition Plants in National Defense Program**

**Ordnance Department**

| Type | Total Program No. | Total Program Cost | Contracts Awarded Location | Contracts Awarded Operator | Contracts Awarded Cost |
|---|---|---|---|---|---|
| Smokeless Powder | 4 | $100,000,000 | Charlestown, Ind. | DuPont | $25,000,000 |
| | | | Radford, Va. | Hercules | 25,000,000 |
| TNT | 6-7 | 100,000,000 | | | |
| Tetryl | 3 | 12,000,000 | | | |
| Picric Acid and Explosive D | 2 | 8,500,000 | | | |
| Cotton purification | 1 | 6,000,000 | | | |
| Ammonium nitrate | 1 | 20,000,000 | | | |
| Ammonia | 1 | 15,000,000 | | | |
| Chemical shell | 1 | 6,000,000 | | | |
| Aviation Gas Storage | Var. | 2,500,000 | | | |
| Total | | $270,000,000 | | | $50,000,000 |

**Chemical Warfare Service**

| | | | | | |
|---|---|---|---|---|---|
| New Arsenal | 1 | 26,500,000 | | | |
| Expanding Edgewater arsenal and Aberdeen proving grounds | | 6,000,000 | Edgewater and Aberdeen | Army | 6,000,000 |
| Commercial plant equipment | 26 | 10,190,000 | | | |
| Total | | $42,690,000 | | | $6,000,000 |
| Grand total | | $312,690,000 | | | $56,000,000 |

## ELECTROCHEMISTS WILL MEET IN OTTAWA

Sessions on electronics and electrodeposition will feature the fall meeting of the Electrochemical Society, Inc., which will be held in Ottawa on Oct. 2-5. This will be the first visit of the Society to Ottawa, the home of a number of important Canadian laboratories. The meetings will be held jointly with the Ottawa sections of the Society of Chemical Industry and the Canadian Institute of Chemists. Frank E. Lathe director of the Chemical Division of the National Research Council, heads the local committee. Most of the sessions will be held in the Chateau Laurier.

Thursday, Oct. 3 will be devoted to sessions on electronics and electrothermics; Friday, Oct. 4 to physical chemistry and batteries; Saturday morning, Oct. 5 to electrodeposition of various metals including indium.

Of the social features, the afternoon of Oct. 3 is outstanding. This will be spent at the Seigniory Club which is 45 miles east of Ottawa and is one of the finest country clubs in the world. At the dinner and dance to be held at Chateau Laurier, honorary membership in the Society will be bestowed upon R. A. Witherspoon, a prominent member of the electrochemical profession and a past president of the Society.

The luncheon speaker on Saturday, Oct. 5 will be M. Marcel Leon Pochon who will discuss the new sources of radium, notably the deposits of the Great Bear Lake in arctic Canada. Mr. Pochon was recently awarded the Randolph Bruce Medal by the Canadian Institute of Mining & Metallurgy for perfecting the process used at the Port Hope Radium Refinery.

## CEASE AND DESIST ORDER ISSUED IN CHARCOAL CASE

The 20-month-old Federal Trade Commission price-fixing and restraint of trade case against major producers in the hardwood charcoal industry reached its semi-final lap last month with issuance of a broad cease and desist order. Respondent companies have 60 days to file statements of compliance and an outline of what they have done to meet the order's terms.

The order applies to manufacturers producing an estimated 65 per cent of hardwood charcoal. It directs that Hardwood Charcoal Co., Manufacturers Charcoal Co., Cliffs Dow Chemical Co., Tennessee Eastman Corp. cease fixing or maintaining identical delivered prices to distributors or dealers. The first two companies named, identified as sales agents for two groups of producers, also are ordered to cease allotting territories, limiting quantities of sales, refusing to solicit each other's customers, limiting the number of distributors or dealers and exchanging information as to prices, sales policies and similar matters.

Canadian War Memorial and Chateau Laurier

Hardwood charcoal is used principally as a fuel. Recently, however, the Army has placed an educational order with the Carlisle Lumber Co., Onalaska, Wash., for a non-coconut charcoal as an experimental substitute for coconut charcoal in gas mask manufacture. The Carlisle Co. was not a respondent in the FTC case. Also, hardwood charcoal is a raw material in manufacture of black powder, used by Army and Navy chiefly for fuses and salutes. Coconut charcoal is on the Army's critical items list.

## NEW SUPPLIES OF QUICKSILVER INDICATED BY SURVEY

Promising new supplies of quicksilver in the Bottle Creek district of Nevada and the Mt. Diablo district of California are reported in field surveys completed by the Geological Survey as part of its program for seeking new sources of strategics for national defense. The geologic setting in the Mt. Diablo district, near San Francisco, is such as to encourage the hope that new supplies can be profitably mined. The lodes are in fracture zones near the footwalls of inclined rocks.

In the engineering sense, no additional reserves have yet been proved in the Bottle Creek area, but the Survey estimates probable reserves of known dikes at roughly 3000 flasks. (76 lbs.) It is estimated this can be mined profitably as long as the quicksilver price remains at $125 or more a flask. Ore shoots mined in the dikes are commonly small but high grade—averaging around 30 pounds to the ton.

## ELEVEN NEW GAS PURIFICATION PLANTS ANNOUNCED

Unusual activity in the field of gas purification is evidenced by an announcement of The Girdler Corp. of Louisville, that eleven new Girbotol purification plants have recently been installed or are now under construction.

In West Virginia, plants for the removal of hydrogen sulphide from natural gas have recently been completed by both the United Carbon Co. and Godfrey L. Cabot, Inc., while the United Fuel Gas Co. has converted its dehydration plant at Clio to a combination dehydration-desulphurization unit. Another natural gas purification plant is that of the Tri-Ess Corp. recently placed in operation in the Amargoza field in Texas.

For the purifying of feed stock at its new thermal polymerization plant at Wichita Falls, Texas, the Continental Oil Co. has installed a plant and a similar installation is under way for The Lion Oil Co. of El Dorado, Arkansas. At Midland, Mich., a plant is under construction for The Dow Chemical Co. for the removal of $H_2S$ from hydrocarbon gas.

The four other plants announced are for the removal or recovery of $CO_2$. Included are installations by the Procter & Gamble Co., Merchants Carbonic Corp. at St. Louis, and a plant being built by The Lummus Co. for the Wabash Portland Cement Co. at Osborn, Ohio, for dry ice production. The Gas Machinery Co., Cleveland, is building a plant for scrubbing $CO_2$ and water vapor from natural gas at the East Ohio Fuel Gas Co.'s new gas liquefaction plant at Cleveland.

## LARGER OUTPUT OF BYPRODUCT SULPHURIC ACID LAST YEAR

According to a report from the Bureau of Mines, the output of byproduct sulphuric acid at copper and zinc plants in 1939 amounted to 778,441 short tons in terms of 60 deg. acid. Of the total 249,569 tons was produced at copper plants and 528,872 tons at zinc plants. The figures do not include acid made from pyrites concentrates in Montana and Tennessee. Some acid recovered as a byproduct in roasting high sulphide gold and silver concentrates is included. In addition, 102,663 tons of acid was produced at zinc plants from 26,500 tons of sulphur.

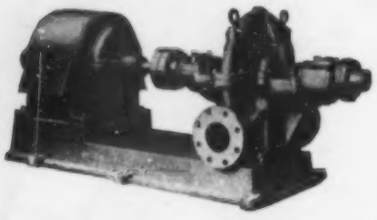
In 1938, production of byproduct acid was reported at 687,176 tons of which 220,297 tons was recovered at copper plants and 466,879 tons at zinc plants. A production of 30,996 tons from 8,248 tons of sulphur also was reported at zinc plants.

PHTHALIC ANHYDRIDE
In converting the resources of nature into chemicals for industry, Monsanto applies the utmost in technical knowledge and manufacturing skill.
High in importance on the list of Monsanto Chemicals are such products as Phthalic Anhydride and other intermediates, the quality of which has been proved through many years of satisfactory use.
Specifications and uses of Phthalic Anhydride are listed herewith. For further information and samples, inquire: MONSANTO CHEMICAL COMPANY, St. Louis, U. S. A.
USES
Phthalic Anhydride is used in manufacture of:
1. Resins and Synthetic Enamels: in preparation of alkyd resins where it is condensed with glycerine and various drying or semi-drying oils.
2. Plasticizers: Dibutyl Phthalate, Diamyl Phthalate, Dimethyl Phthalate, Diethyl Phthalate and various phthalyl glycollates.
3. Dye Intermediates: including Anthranilic Acid, Methyl Anthraquinone, Chlorphthalic Acids and Anhydrides, and Quinizarin.
4. Dyes: Xanthene Dyes, Acridine Dyes, Quinolin Dyes, and also of Anthracene Brown, Hydron Yellow and Sirius Yellow.
5. Alcohol Denaturants: Diethyl Phthalate.
6. Pharmaceutical Products: Phenolphthalein and Phthalated Urotropine.
7. Perfumery Products: Methyl Anthranilate, Ethyl Anthranilate and Diethyl Phthalate.
SPECIFICATIONS
Mol. Wt. $C_6H_4(CO)_2O$ = 148.06
Appearance: White Flakes
Crystallizing Point: 131°C. minimum
Solubility in Benzene: 1:20, complete
Purity: Essentially 100%
MONSANTO CHEMICALS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

# The MORRIS HYDRAULIC COLUMN

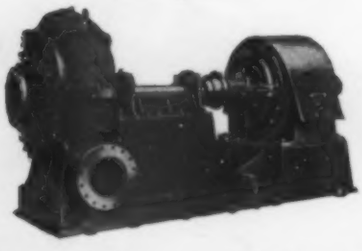
*News of interest to Centrifugal Pump Users*

## PUMPS that quickly repay their cost



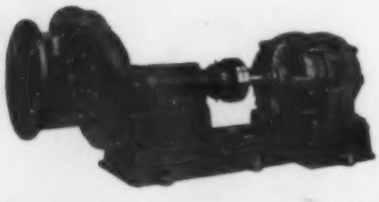
### Through higher efficiencies

It isn't so long ago that 75% was considered a high efficiency for a clear water centrifugal pump. However, today, the remarkably high efficiencies of Morris Pumps will save 10% or more of the power required by older pumps. Figure for yourself what this would mean to you—and then investigate Morris Pumps.



### Through lower maintenance

When pumps are to handle abrasive materials, simple design, long wearing metals, and provision for economical replacement are essential. Operating records prove that Morris abrasive-handling pumps have these characteristics.



### Through greater capacity

Morris designs for pulpy mixtures are guaranteed not to clog or air-bind, and have far greater capacities than other designs.

***Write for descriptive bulletins***

MEMBER

For authoritative recommendations on any pumping problem, write to Morris Machine Works, Baldwinsville, N. Y. Representatives in principal localities. *Export Office*, 30 Church St., New York.


## GERMANY REPORTED TO BE OFFERING DELIVERY OF CHEMICALS TO SOUTH AMERICA IN OCTOBER

**From Our German Correspondent**

REPORTS that German manufacturers are promising deliveries in October in South America are of interest. Whether the Reich will be in a position to fill these orders remains a question but the situation will be important in the light of the Havana conference of American Republics.

As in the last war, with overseas communications cut, United States' Latin-American trade has increased as Great Britain, Germany, France, and Japan have experienced increasing difficulties in supplying these markets. By 1920 after the close of the World War the United States had acquired a share of Latin-American trade valued at over 3 billion dollars. By 1929 it had declined to 2 billion, and by 1938, even though the United States still led in South American trade, its exports to Latin-America had dropped to 500 million dollars and imports to 450 million. Great Britain and Germany were the United States' closest competitor. In some countries in 1938 imports from Germany exceeded those from the U. S. In that year, for example, Brazil imported 74 million dollars worth of goods from Germany and 70 million from the U. S., Chile 27 million from the Reich and 24 million from the United States, and Uruguay 20 million dollars worth of goods from Germany as against 10 million from the United States.

Chemicals have always figured prominently in Germany's South American trade, especially in Argentina, Brazil, and Mexico. Normally the Latin-American countries import chemicals valued at 90 to 100 million dollars, one-third to one-half of which is supplied by the United States. From 1937 to 1938 U. S. chemical exports to South America declined from 37 to 32 million dollars in value. In 1926 after the Reich had recovered some of her world-war losses in South American trade it exported 10 million dollars worth of chemicals and allied products to Latin-America; by 1938 it supplied 25 million dollars worth. During this interval the Reich's largest chemical trade increases were to Brazil (1926: 3.7 million dollars, 1938: 5.5), Argentina (3.2 to 5.5 million dollars), and Mexico (2.5 to 4.4 million dollars).

When the chemical trade figures are analyzed, it becomes apparent that the German increases during the past 15 years have been most striking in the field of medicinals. Last year, for example, approximately 50 per cent of the Reich chemical exports to South America were medicinals, 18 per cent coal-tar products, 5 per cent photographic materials, 5 per cent explosives, 4 per cent fertilizers, and the remainder miscellaneous chemical products.

Since the outbreak of the war last September the United States has captured much of this trade, especially since other important chemical suppliers, Great Britain, France, Switzerland, and Japan have also had difficulties making deliveries. In the meantime, however, many of the German sales organizations in South American countries have been kept intact, partly for propaganda purposes, but they will be in a relatively favorable bargaining position, if and when trade might be resumed, because they are anxious to take over raw material surpluses which have been piling up in America since the war started and which the United States would have difficulty in absorbing under normal circumstances.

The Havana declarations may counteract this tendency, but in the past Germany has profited by using Aski- and Sperrmarks in paying for large South American purchases of coffee, meat, wheat, rubber, and other raw materials in exchange for German manufactured products. South American buyers in the past have stated that European suppliers had an advantage over American exporters in offering lower prices, longer credits, collective buying of South American raw materials on an exchange basis, convenient transport facilities with more uniform freight rates, packaging of goods better able to withstand rough freight handling, and products better adapted to the needs of Latin-American purchasers. The presence of European nationals speaking the local language and closely studying local market needs, as well as a general cultural affinity of South Americans with Europeans have been factors which have aided European trade. The relative importance of these factors in the future will depend partly on the degree of cooperation achieved between North and South America and upon the adaptability of American products to meet South American needs.

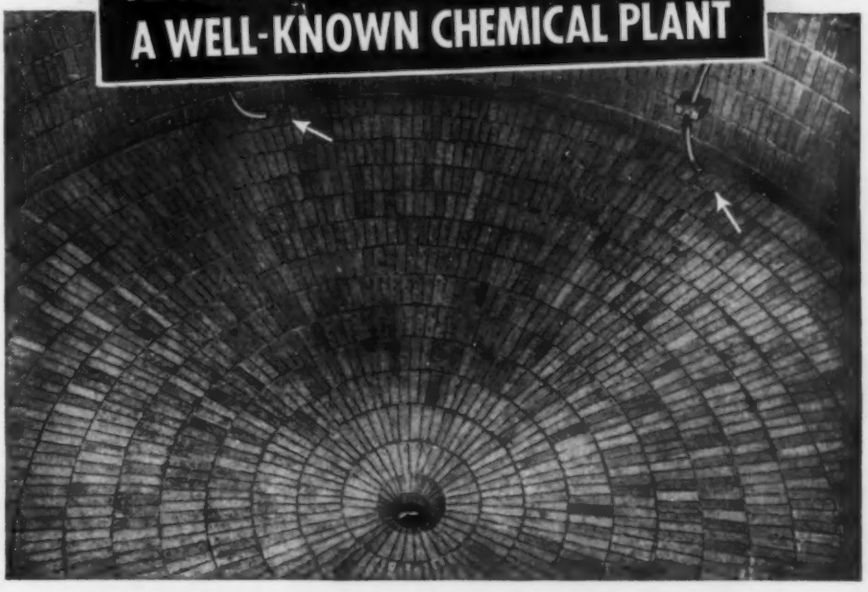
The intensification of military operations with enormous consumption of war materials is increasing demands on the arms and munitions industries. It is also reflected in the further curtailment of production of consumer goods; production for the domestic market of sewing machines, refrigerators, household appliances, and many kitchen utensils.

How Germany's total foreign trade is holding up cannot be definitely calculated because it has issued no foreign trade figures since August of last year. In the case of trade with non-belligerents still publishing figures, Germany's share can be estimated. The annual reports of some of the large industrial concerns also give some clue as to the trend in exports. But Soviet shipments to the Reich remain obscure since neither country is releasing figures. At the opening of the war the Reich claimed it could maintain 80 per cent of its pre-war trade volume. Conservative estimators feel the trade can hardly be over 60 per cent. While the Reich's continental control of coal and iron ore is an advantage, the overrunning of the Low Countries and Scandinavia has brought the disadvantage of plugging up former importing loopholes through peripheral countries now blockaded. This is important for some items which the continent itself cannot furnish, especially is this true in the textile field.

In view of the Reich's present strategic position in eastern Europe with enemy competition virtually eliminated, the lack of foreign exchange to pay for imports is not the drawback it might have been. German coal, iron, steel, chemicals, and fertilizers are exchanged for Rumanian oil and foodstuffs, for Yugoslav ores, for Hungarian wheat, for Bulgarian cereals and farm products, for Swedish iron ore, pulp and paper, for Danish bacon, butter and eggs, for Norwegian fish, and for Soviet oils and ores. According to Budapest reports, Germany's share in Hungarian foreign trade now exceeds 70 per cent of its imports and exports, and is around 65 per cent of Bulgaria's. In June the Reich, including the Bohemia-Moravia Protectorate, took 47 per cent of Yugoslavia's exports and supplied 51 per cent of her imports. Turkey and Greece, who tried to conduct an independent economic policy are now negotiating for closer economic relations, and figures for the first four months of 1940 indicate that despite a sharp drop in trade, the Reich was still the leading trade partner of both countries.


# PENCHLOR

## ACID-PROOF CEMENT LIKE NEW AFTER THREE YEARS' SERVICE FOR A WELL-KNOWN CHEMICAL PLANT



Inside of tank lined with brick laid in Penchlor Acid-Proof Cement. Note excellent condition of joints at steam injection points.

**THIS calcium sulphate precipitating tank 14 feet in diameter and 28 feet high, has been steadily in service for three years. Yet the Penchlor Acid-Proof Cement* in which the brick lining was laid is as sound and serviceable as new. It has resisted the mixture of sulphuric acid and lime which is especially severe in a batch process of this type, where the temperature rises rapidly from 70° F. to 260° F.**

**In addition to stirring by mechanical agitation, the contents of this tank are boiled for several hours by the injection of steam. Following discharge the tank is immediately ready for a new batch. This is typical of the service which Penchlor Acid-Proof Cement is withstanding in plants the country over. It is inert to all acids except hydrofluoric. It adheres strongly to such materials as brick, steel, carbon, glass, lead and rubber.**

**Many plants prefer Asplit Cement,* a synthetic resin which is unusually resistant to the most severe abrasion and thermal shock. Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.— New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.**

**WRITE FOR FREE TEST KIT.** You can prove for yourself the outstanding properties of these acid-proof cements, and make a convincing comparison with the product you are now using, by means of the free Test Kit supplied on request. Write us today on your business letterhead.

*Fully protected by *existing* patents.

**PENNSYLVANIA SALT MANUFACTURING COMPANY**

*Chemicals*

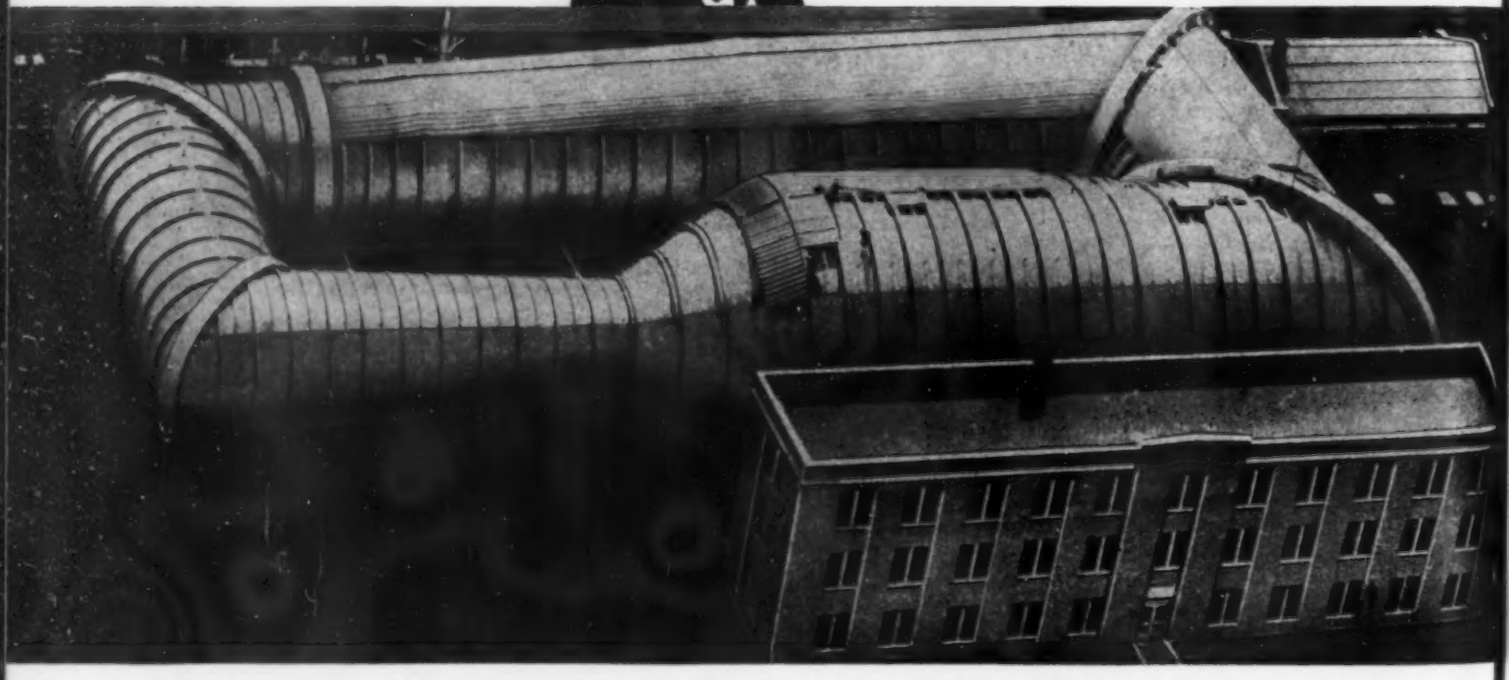
# *Another Outstanding*

# P·DM ACCOMPLISHMENT

## IN PRECISION PLATE FABRICATION and ERECTION

*. . . PROVING YET AGAIN*

*"WHEN ABILITY COUNTS FOR MOST— IT PAYS TO CALL IN P·DM"*



## ● WIND TUNNEL FOR LANGLEY FIELD, VA.

Latest in the incomparable array of N.A.C.A.'s research instruments is this unique Wind Tunnel by P·DM. The largest of its kind in the United States, the tunnel is 19 feet diameter at the throat, creates air speeds as high as 250 m.p.h., and affords controlled variable air pressures.

Fabricated and erected by Pittsburgh-Des Moines, the huge all-welded structure represents what is probably the most complicated job of welding of its size ever performed in this country. 2000 tons of steel entered into its construction, requiring the use of an entire carload of welding wire in assembly.

Exceptional as this project was in its demands upon the ingenuity of P·DM's engineers and the skill of P·DM craftsmen in plant and field, the same "know how" that we apply to *every* job eased and speeded the task. Proof of the success attending this precision P·DM operation is demonstrated by the fact that we are now completing a *second* great wind tunnel at this location, and are commencing the construction of a *third*.

Do you have a difficult platework assignment in the offing? P·DM's skill, accuracy and experience in handling the widest variety of tough jobs are *yours—at low cost*. Let us have your inquiry!

P·DM

**PITTSBURGH · DES MOINES STEEL CO.**

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# PERSONALITIES

*Harris & Ewing*

**National Inventors' Council of the Department of Commerce**

✦ WEBSTER N. JONES, president of the A.I.Ch.E. and other members of the National Inventors' Council of the Department of Commerce, pictured here at its first meeting, has job of examining all ideas submitted on national defence. Left to right: Fred M. Zeder, Chrysler Corp.; Dr. Fin Sparre, du Pont company; Conway P. Coe, U. S. Patent Commissioner; Dr. Jones; Fred. M. Feiker, George Washington University; Dr. Charles F. Kettering of General Motors; Lawrence Langner, lawyer; Dr. Thomas Midgley, Ethyl Gasoline; Watson Davis, Science Service; Dr. W. D. Coolidge, General Electric.

✦ DONALD COMER, president of Avondale Mills, Birmingham, Ala., has been named by President Roosevelt as director of the Textile Foundation. He fills the unexpired term of the late Stuart W. Cramer which expires June 11, 1941. In his position as director, he will be associated with the others determining policy for scientific and economic research for the textile industry and related studies on raw materials and chemical processes.

✦ E. L. LUACES has established an office in New York where he will engage in patent practice in the fields of chemistry, metallurgy and engineering, in which he has been active during the past 16 years. Mr. Luaces was for a number of years associated with General Norit Co., West Virginia Pulp & Paper Co., and E. L. Luaces & Associates, and for five years supervised the engineering and patent activities of Acti-carbone Corp.

✦ N. D. MORGAN, horticulturist at the North Louisiana Agricultural Experiment Station, has resigned to join the field staff of the American Potash Institute. In his new position he will carry on the educational program of the Institute in the Southwestern States.

✦ W. F. LAMOREAUX and J. B. WARNER have formed the firm of Southern Chemical Research and Sales at Chattanooga.

✦ R. W. THOMAS, head of Phillips Petroleum Co.'s Philgas Department, was elected president of the Hydrocarbon Chemical & Rubber Co. at a recent meeting of the board of directors. Other officers elected are: Waldo L. Semon, vice president and director of research; Hy Byrd, secretary and Herman P. Gangwer, treasurer. The newly formed Hydrocarbon Chemical & Rubber Co. was organized by the Phillips Petroleum Co. and the B. F. Goodrich Co. to manufacture a new synthetic rubber. In addition to his duties as president of the new company, Mr. Thomas will continue as head of the Philgas Department with Mr. A. B. Cameron as manager.

✦ A. GORDON KING, who has been for a number of years an engineer on the staff of American Gas Association, was named as secretary of the Technical Section, effective August 1. Mr. King succeeds the late Hugh W. Hartman who had been secretary of this section since the founding of the Association.

✦ JAMES E. LOUNSBURY, JR., has announced the establishment of a chemical consulting office in New York.

✦ A. QVISTGAARD PETERSEN, who since his arrival in this country from Denmark in 1907 has been an associate of the late A. D. Geoghegan, was elected to succeed him as president of the Wesson Oil and Snowdrift Co. on August 9. He had been vice president and active in the management of the company since its organization.

✦ PALMER B. STICKNEY has joined the technical staff of Battelle Memorial Institute, Columbus, Ohio. He has been assigned to the division of chemistry. Under the supervision of Dr. Edward March, Jr., Mr. Stickney is to study the kinetics of the thermal decomposition of hydrocarbons.

✦ DERICK S. HARTSHORN, JR., has been appointed technical director of the Enthone Co. He will supervise development of new products and also do sales engineering work. Mr. Hartshorn received his technical training at the University of North Carolina and for the past seven years has been associated as chemist with Westinghouse Electric & Mfg. Co., East Springfield, Mass.

✦ L. B. LENT of New York City has been named executive secretary of the American Engineering Council, succeeding F. M. Feiker, who resigned recently to become dean of engineering at George Washington University.

✦ W. P. ANDERSON, chairman of the

## CALENDAR

**OCT. 2-5.** Electrochemical Society, fall meeting, Ottawa, Canada.

**OCT. 7-10.** American Gas Association, Atlantic City.

**OCT. 28-30.** Association of Official Agricultural Chemists, annual meeting, Raleigh Hotel, Washington, D. C.

**OCT. 21-25.** National Metal Congress, Cleveland, Ohio

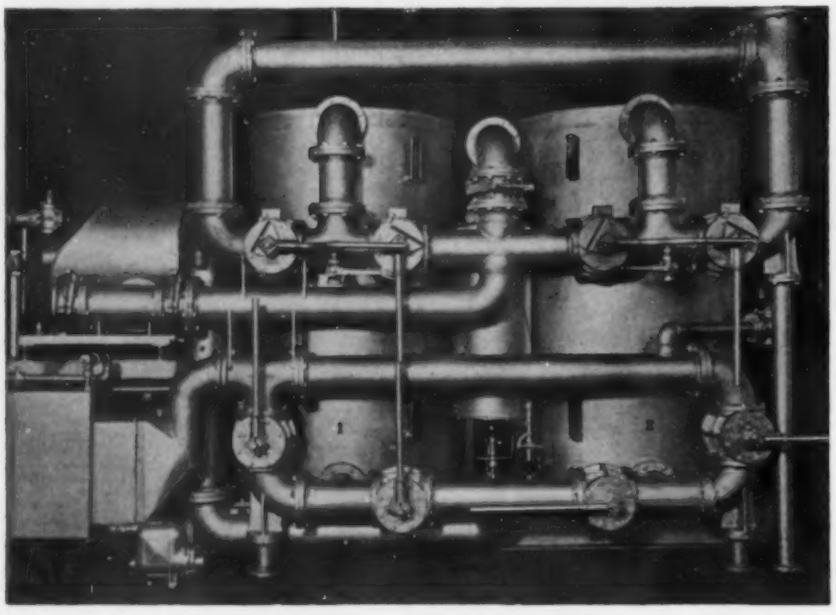
**DEC. 2, 3, 4.** American Institute of Chemical Engineers, New Orleans, La.

**DEC. 11-15.** National Chemical Exposition, Chicago, Ill.

# MODERN ADSORPTIVE DRYERS

## use *Silica Gel* for

## CONDITIONING OF GASES AND AIR



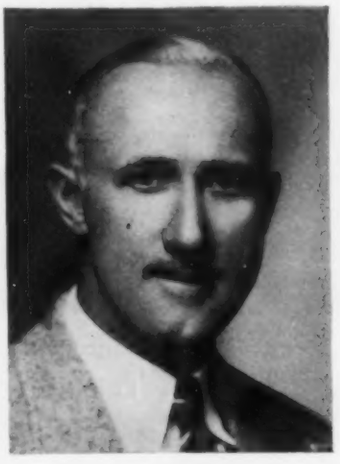
Dependable, economical drying even down to extremely low dewpoints, is realized through the use of Silica Gel in Modern Adsorptive Dryers operating in all types of industries.

Silica Gel is the most amazing dehydrating agent known to science. It is composed of a myriad of ultra-microscopic pores, drawing moisture from the gases or liquids under treatment by a purely physical action of surface adsorption and capillary attraction.

Complete Silica Gel Adsorptive Dryers are now available, designed for your needs by large industrial equipment manufacturers of long experience. Find out what is being done with Silica Gel in *your* industry today . . . Write to **The Davison Chemical Corporation, Silica Gel Department, 20 Hopkins Place, Baltimore, Md.**

**THE DAVISON CHEMICAL CORP.**


board of the Ferro Concrete Co., was awarded a commemorative plaque by the combined building industries of Greater Cincinnati. The award was made for his erection of the Ingalls Building in 1902. It was the first large concrete office structure erected anywhere. Mr. W. J. Reardon of the Reardon Color & Chemical Works, was selected to make the presentation address.



**Henry J. Masson**

✦ HENRY J. MASSON for 23 years a member of the instructional staff of the New York University, has been appointed as acting director of the evening division of the college of engineering. Dr. Masson who is now professor of chemical engineering and director of the graduate division of the college of engineering, is widely known in the process industries.

**J. Oostermeyer**

✦ J. OOSTERMEYER has been made vice president of the Shell Chemical Co. of San Francisco. He has been affiliated with Shell interests for the past 23 years and lived in the Orient and South America where his activities were concerned with the marketing of petroleum products.

✦ RODERICK M. LADD has joined the sales staff of Hooker Electrochemical Co. He will be engaged in promoting the sale of the general line of Hooker chemicals in the metropolitan New York area.

✦ CORBIN T. EDDY has been promoted from associate professor in the department of metallurgy and mineral dressing to professor and head of the department of metallurgical engineering at Michigan College of Mining and Technology. Dr. F. A. Rohrman and Dr. Glenn Damon have been promoted from assistant to associate professors in the department of chemistry and chemical engineering.

✦ ROBERT E. WEAN of Purdue University staff has joined the Agricultural Research Division of the Stauffer Chemical Co. His work will consist chiefly in giving technical assistance to growers and other Stauffer customers on problems relating to soil corrective treatment, insects and disease control and other phases of agriculture.

✦ HENRY L. COLES, head of the department of chemical and metallurgical engineering at the University of Alabama, has accepted the head of the department of chemistry and chemical engineering at the Michigan School of Mines and Technology, Houghton.

✦ REGINAL M. BANKS has been appointed assistant to the president of American Cyanamid Co. to promote coordination of research and sales activities of the company.

## OBITUARY

✦ WILLIAM LASH MILLER, head of the University of Toronto chemistry department, died September 1 at the age of 73.

✦ A. D. GEOGHEGAN, president of the Wesson Oil and Snowdrift Co., died August 1 in New Orleans at the age of 63. Born in Fayette, Miss., Mr. Geoghegan became a resident of New Orleans in 1909 at which time he began, an active career which brought him to a place of leadership in business and banking.

✦ CHARLES FREDERIC DREW, secretary and treasurer of the Rust Engineering Co., Pittsburgh, died August 4.

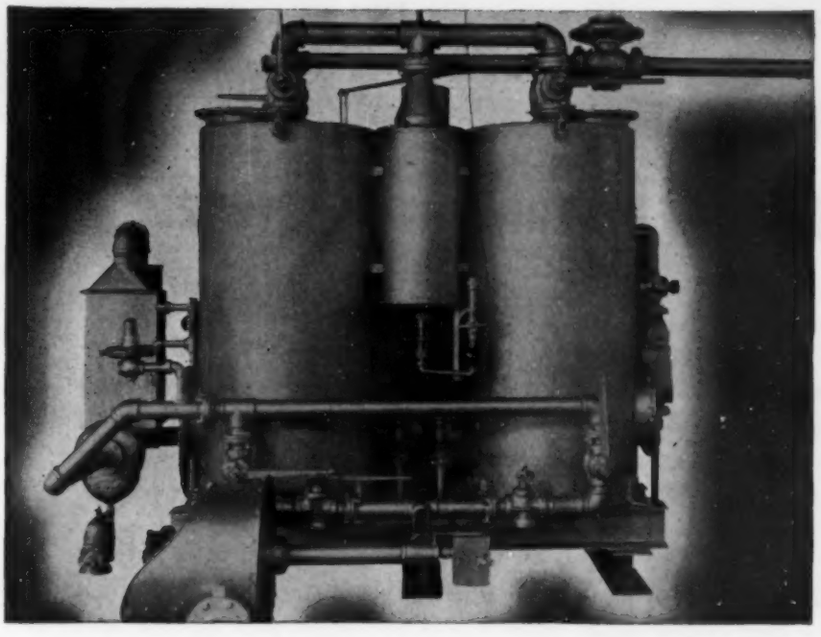
✦ STANLEY P. ROCKWELL, metallurgist and inventor of the Rockwell hardness tester, died August 11, as the result of an explosion on his yacht, anchored in the Connecticut River at Middletown.

✦ WILLIAM L. FEWSMITH, manager of publicity and advertising for Robins Conveying Belt Co., Passaic, N. J., died after a brief illness while on vacation at Port Carling, Ont., August 15, at the age of 61.


# KEMP ADSORPTIVE DRYERS

## use *Silica Gel* for

## CONDITIONING OF GASES AND AIR

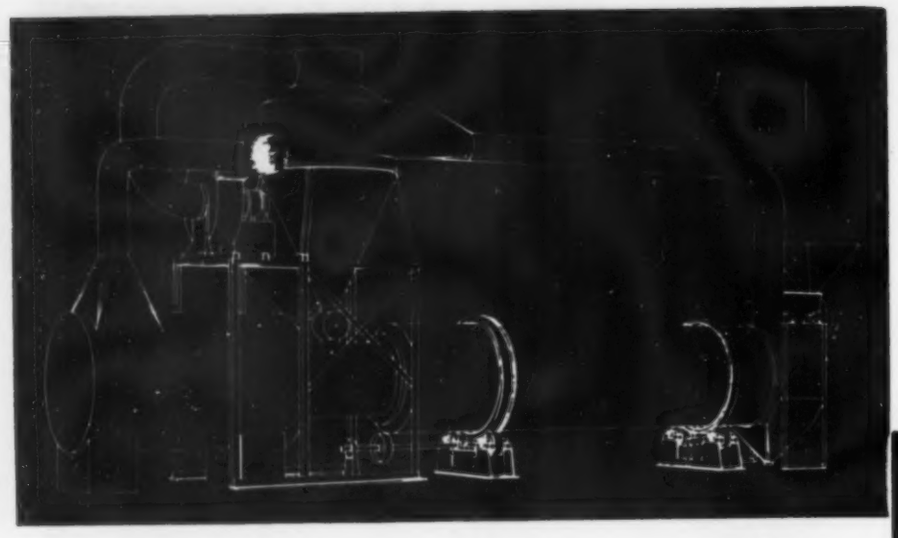


You can depend on Kemp Adsorptive dryers for dehydration of gases and air to any required degree down to the commercial absolute, -76°C.

Available with single or twin towers for intermittent or continuous operation, standard Kemp units are built from 10 to 100,000 c. f. per minute capacity to operate at pressure from atmospheric to 2,500 pounds per square inch. Activation of the Silica Gel is accomplished by gas, electricity, or steam as desired.

Already well established in the Chemical, Steel, and Food Industries, Kemp Adsorptive Dryers live up to the 62 year performance record of Kemp Equipment. For a new Dryer Bulletin giving further details, address **The C. M. Kemp Mfg. Co., 405 East Oliver Street, Baltimore, Md.**

**KEMP of BALTIMORE**



# HERSEY INTERMEDIATE SYSTEM

The Hersey Intermediate Feed System shown here comprises a concurrent, direct-fired dryer with a cyclone type dust separator in the gas line and provision for introducing the material to be dried into the duct conducting the gases from the discharge end of the Dryer to the cyclone.

One purpose of this arrangement is to effect substantially complete recovery of the dust. This is accomplished when the dust-laden gases from the dryer drum pick up the wet feed and the fine particles adhere to the wet material.

A second advantage is that introducing the cold wet material into the partially cooled gases from the dryer drum enables it to pick up much heat therefrom which would otherwise be lost. This results in a high overall gas temperature drop which means high efficiency. Its intrinsically high drying efficiency is augmented by the Hersey thermostatic control system which automatically maintains ideal drying conditions through wide fluctuations of the material feed rate.

The Hersey Intermediate Feed System combines to a large extent, the humidity and temperature balance advantage of the common counter-current flow type of dryer, with the advantages of the concurrent flow type.

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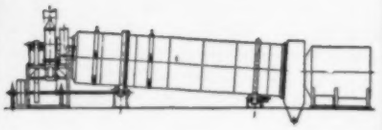
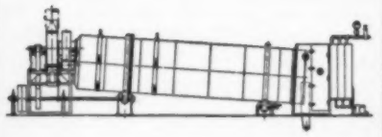


HERSEY COUNTER-CURRENT DIRECT HEAT DRYER



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# Synthetic Textiles and Synthetic Rubbers Hold Spotlight at A.C.S. Meeting

**More than 4,000 chemists and engineers gathered in Detroit last week to celebrate the American Chemical Society's 100th meeting. Hundreds of papers were presented and 35 plant trips were scheduled. Interest centered around papers on nylon and butyl, synthetic fiber and synthetic rubber, described technically for the first time.**

THREE HIGHLIGHTS characterized the opening session of the American Chemical Society's 100th meeting: (1) Dr. Per K. Frolich literally "stole the show" with his animated colored movies showing the molecular structure of butyl rubber, a new synthetic (see abstract on page 651); (2) the Council authorized a National Defense Roster and the classification of 40,000 American chemists and chemical engineers; and (3) the Committee on Education decided to accept the A.I.Ch.E. accrediting for engineering schools.

Abstracts of selected papers presented at other sessions follow, headed by the symposium on synthetic textiles.

### NYLON

Dr. G. P. Hoff, director of nylon research for E. I. du Pont de Nemours & Company, afforded his fellow-chemists a behind-the-scenes glimpse of nylon's molecular structure which endows the textile with characteristics not possessed by any other fiber, either synthetic or natural.

Describing the process employed to manufacture nylon, Dr. Hoff explained it was essentially a matter of "condensation reactions" in which small molecular units are built up to large molecules. He likened this to a chain of paper clips, the individual links forming a "molecule" of comparatively great length.

"With an adequate degree of polymerization," he said, "a tough horn-like nylon 'polymer' is obtained. The molten mass is extruded as a ribbon and ground to granular form. It has a crystalline structure and melts sharply. It is completely stable and may be stored any length of time until required for the spinning of the yarn.

"The flake is melted and then extruded from a spinneret and the resolidified filaments collected on a suitable package. At this stage, although the material is crystalline and not amorphous, the molecules have essentially random distribution."

This helter-skelter pattern, with the molecules lying like straws in a hayrick, is overcome by stretching or "drawing" the yarn. This process regiments the molecules in orderly array.

"Visualize these long-chain molecules within the filaments lying in all directions, twisted and coiled and wrinkled," Dr. Hoff invited his audience. "In this form the fibers have relatively little practical use and it is necessary to bring about orientation through stretching of the filaments. Relatively little force is required to accomplish a four-fold increase in length. This new length and proportionately reduced diameter are the permanent attributes of the stretched or drawn yarn."

Dr. Hoff pointed out the numerous hurdles which had to be negotiated before satisfactory nylon hosiery became a reality. Protective coatings to simulate the natural film found on silk, for example, had to be devised.

"During hosiery manufacture the stockings are handled frequently, and it is easy to snag and pull out individual filaments unless suitable protection is given them," he narrated. "This is a problem with natural silk, although it has a protective coating called 'sericin' which binds the filaments together. The sericin softens during the wetting-out of the yarn and hardens again on evaporation of the moisture to give a firm fabric with all the stitch loops held in place. It was necessary to find a material called a size which would do for nylon what sericin does for natural silk, to protect the filaments during the various handling operations, and which could easily be removed after it had served its purpose."

Nylon in the form of yarn, or in other forms, is difficultly soluble in most reagents, Dr. Hoff said. Phenols and formic acids are active solvents, but all the common dry cleaning solvents are without effect. While the resistance of nylon to mineral acids is "not remarkable," it is quite resistant to alkalis even in fairly concentrated solutions, and even at high temperatures, he showed.

### OTHER TEXTILE FIBERS

Vinyon was described by F. Bonnet of American Viscose Corp., as a copolymerized vinyl resin made of vinyl chloride and vinyl acetate. The vinyl acetate internally plasticizes the chloride making the resin stable. Polymerization takes place at the double bond and gives a straight-chain linkage which is important for a resin textile. Then the copolymer is dissolved in acetone and spun in air as in cellulose acetate. The spun yarn is not strong, but after stretching several hundred per cent may obtain a strength of 80,000 lb. per sq. in. It is quite resistant to strong acids and alkalis at ordinary temperatures. It is practically water repellant and is as strong wet as it is dry.

Vinyon can be dyed. It is thermoplastic and shrinkage takes place if heated above 65 deg. Largest use at present is in industrial filter cloth.

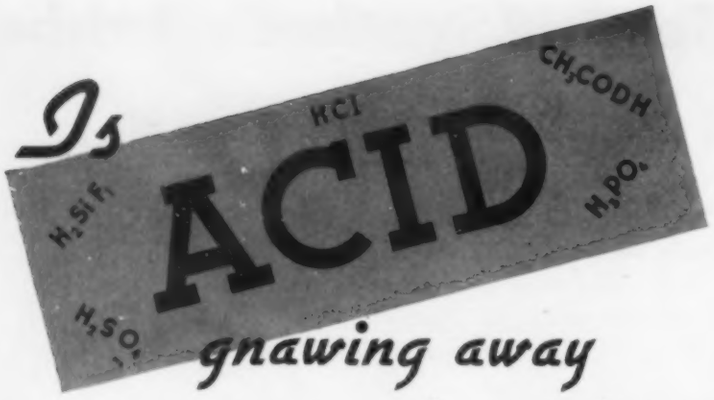
Another paper described the form, properties and uses of cellulose acetate rayon, which now accounts for approximately 30 per cent of the total rayon production. The process of manufacture, wherein the filaments are produced by extruding an acetone solution of cellulose acetate into warm air under control conditions, was described briefly.

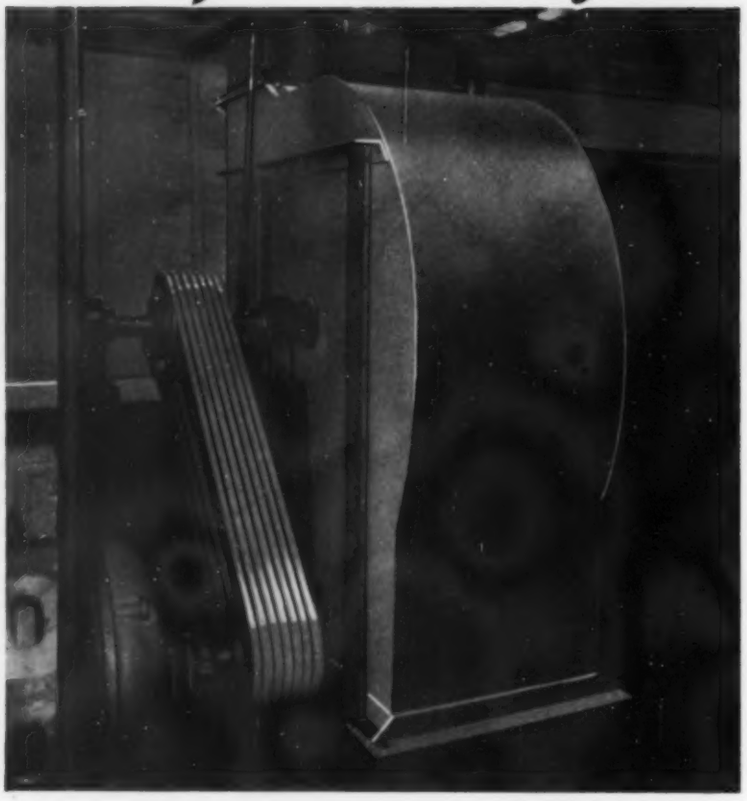
Games Slayter of the Owens-Corning Fiberglas Corp., described the unusual properties and uses of fibers made of glass. These fibers are produced in two basic forms; as a wool-like fiber largely used for thermal insulation and as a textile fiber, either continuous or in staple lengths, employed to form yarns, threads and woven fabrics of wide utility.

Wool forms are used in large quantities for insulation in houses, ships, trains, aircraft; ranges, refrigerators, and similar equipment; and for industrial insulation at temperatures from below zero to over 1,000 deg. F. Textile forms are used extensively for electrical insulation purposes, for electric storage battery retainer mats, for certain chemical and fume filtration services, and for a wide variety of service fabrics for industrial applications. Decorative fabrics have found many practical applications. Glass fabrics are not recommended for wearing apparel.

Production of fiber from soybean proteins was described by R. A. Boyer of the Ford Motor Co. Difficulties encountered in obtaining uniform proteins necessitate strict control of the variety of the soybean and thorough chemical analysis and utilization of the soil on which they are grown, he said. When good protein is used, spinning solutions containing 20 per cent protein are possible to obtain. Soybean fibers as made at present, have about 80 per cent the strength of wool; they have more elongation both wet and dry, and do not wet as easily as wool or casein fiber. They do not promote mold growth as readily as casein fiber. The fibers blend well with wool and cotton and have been processed satisfactorily on cotton and worsted textile equipment. Plans are being made for a pilot plant capable of producing 1,000 lb. per day of soybean fiber.

Natural protein-base spun fibers, principally those made from milk casein, were dealt with in the final



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paper of the session. Commercial fibers of this class were shown to be compound of some type formed from the protein as a base rather than simple regenerated proteins. The compound is formed after the fiber is spun, in contrast to present synthetic fibers which are either regenerated cellulose or compounds which are formed prior to spinning as a solution or melt.

A specification was drawn up showing qualities such protein-base fibers will probably be required to meet before commercial success is achieved. The present commercially available fibers of this class have been assembled and tested and compared with the specification, it was said. Further data were given in the paper as to latest reports of world production of this class of fiber and the uses to which it is put.

An intriguing process for making pile fabrics such as velvets by electrocoating was described earlier before the Textile Group. It consisted in the adaptation of the 8-year old electrostatic process of making sandpaper to the making of textiles. An adhesively coated backing is fed continuously between electrodes with the backing adjacent to the upper electrode and the adhesively coated side downward. Textile fibers cut to uniform lengths are carried between the electrodes by a belt which travels adjacent to the lower electrode with the fibers facing upward. The fibers are charged with the sign of the bottom electrode, stand erect, move to the adhesively coated backing sheet and are embedded in the adhesive. Since the fibers are all charged with the same sign, they repel each other, automatically producing uniform distribution. Pile fabrics having a density as high as 275,000 fibers per sq. in. are easily obtained.

### SYNTHETIC RUBBERS

New developments in rubber are headed by the announcement of Butyl rubber, a new synthetic, by Standard Oil Development Co. A paper describing the properties of the new substance and its proposed field of usefulness was presented before the general session by Dr. Per K. Frolich on behalf of his four collaborators.

Dr. Frolich said in part, "Through long years of research, the Esso Laboratories have now developed a method of copolymerizing olefines with small amounts of diolefines to give just the proper degree of unsaturation (for vulcanization)—but no more.

"Out of these efforts have come butyl rubber, which after vulcanization is a product with substantially no chemical unsaturation. As a result it is characterized by remarkable stability and durability."

Several papers describing various aspects of other synthetics were presented before the Division of Rubber Chemistry.

Fundamental differences between rubber and the cyclized rubber derivative,

Pliolite, were discussed in one paper. The uses of various compounds of Pliolite and rubber and the technique of making these compounds were discussed. In general Pliolite functions as a resilient stiffening, toughening, compounding ingredient which analyzes chemically as rubber.

A similar discussion of Vistanex polybutene was given.

Perbunan, one of the newer synthetics which is scheduled for large-scale production this Fall, was discussed with particular attention to its compounding characteristics. As with natural rubber, sulphur is required for vulcanization and carbon black may be used for reinforcement. However, a quantitative comparison differs materially from a qualitative comparison. For Perbunan it is desirable to keep the sulphur content below 2 per cent. Similar limitations for the various types of carbon black may be determined from data given in the paper.

Results of new studies on the effect of lubricating oils on neoprene vulcanizates were announced by Donald F. Fraser. It has been found that the aniline number of the oil is as good a criterion of the swelling effect on neoprene as the viscosity-gravity constant. The latter index has been used since it was discovered that volume increase at swelling equilibrium is a logarithmic function of it. But the aniline number can be determined much more easily and without special equipment. In some cases it gives even more reliable results.

### PETROLEUM DEVELOPMENTS

Among the papers presented before the Petroleum Division was one by O. M. Reiff of Socony-Vacuum, which described new types of metal organic addition agents for lubricating oils, developed from alkylated phenolic compounds. By the introduction of alkyl substituents derived from petroleum wax, multi-functional addition agents are formed which are capable of imparting combined properties such as pour point depressing action, improved V. I. and anti-oxidant value to lubricating oils. The effectiveness of the multi-functional addition agents is improved by the introduction of metal substituents, particularly in respect to anti-oxidant value. In the paper attention was directed to the importance of the type of solubilizing radical as well as the kind of metal substituent in the formation of metal organic addition agents having anti-oxidant value.

W. J. Sweeney and E. H. McArdle of Standard Oil Development Co., described the production of highly aromatic solvent naphthas from petroleum. While at present manufactured by physical methods of separation from virgin naphthas, increased quantities can be produced by the application of various hydrocarbon conversion processes, they said. Analysis of commercial aromatic naphthas as produced from petroleum has shown aromatic contents ranging from 70 to 90 per


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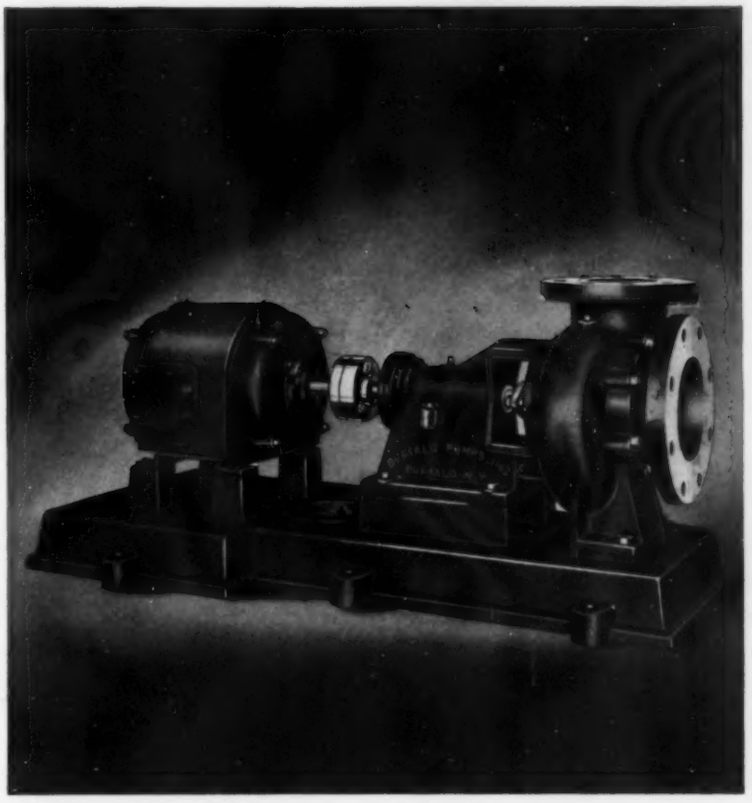

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cent, the principal individual components being toluene, ethyl benzene, xylenes, and mixed $C_9$ and $C_{10}$ aromatic hydrocarbons and the distribution depending on the boiling range to which the naphthas are cut. Tests made to evaluate the applicability of these aromatic naphthas to coating compositions indicate them to be in general equal in solvency and superior in stability to products derived from coal-tar distillates.

### MELAMINE

Melamine is derived as a principal product from cyanamide. It is actually the trimer of cyanamide and has the formula name, 1,3,5-triamino, 2,4,6-triazine.

The tremendous drop in price of melamine makes it interesting as a starting material for many syntheses. Two years ago American Cyanamid Co. began pilot plant production and development of melamine because of its resin possibilities. Full scale commercial manufacture is now under way, with melamine assuming a dominant place in the great field of resins. Melamine resins are somewhat like urea resins, it is explained, but are much better in resistance to heat, moisture and discoloration.

By far the majority of methods of preparation of melamine involve the conversion of cyanamide or dicyandiamide to melamine in one way or another, and a number of patents have disclosed technical details designed to improve the yield and purity.

A discussion of "Melamine-Formaldehyde Film-Forming Compositions" was given by a group of chemists of the Reichhold Chemicals Co. at Detroit.

### NEW PHENOL PROCESS

"Synthesis of Phenol using a Partial Pressure Evaporation Method" was the title of a paper presented by Donald F. Othmer and Charles E. Leyes. The new process, disclosed by Dr. Kokatnur in U. S. Patent No. 2,111,973, can be applied to either the sulphonation or halogenation methods, and basically involves the formation of an intermediate sulphonated or halogenated compound in the presence of an inert diluent (such as gasoline) followed by neutralization and hydroxylation with caustic soda under kerosene. This same principle can be applied to the production of hydroxy derivatives of benzene and naphthalene as well.

Two major developments have been proved in research on the Kokatnur process. The first was that high yields of benzene sulphonic acid can be produced with no sulphone formation using the theoretical molecular proportions of benzene and sulphuric acid by the removal of water of reaction by a naphtha fraction. The second was that 50 per cent caustic soda solution can be utilized in the fusion stage with kerosene (forming anhydrous crystal caustic soda *in situ*) with excellent yields, higher than those obtained with fused caustic.

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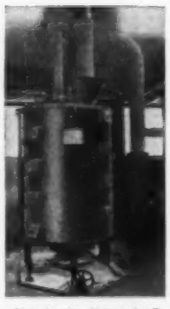

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# New Titles, Editions and Authors

Chem & Met BOOKSHELF

### MORE ABOUT CORROSION

THE CORROSION OF IRON AND STEEL. By *J. C. Hudson.* Published by D. Van Nostrand Co., New York, N. Y. 319 pages. Price $5.75.

THE CORROSION COMMITTEE of the Iron and Steel Institute and the British Iron and Steel Federation invited the author, who is official investigator to the Committee, to write a popular book covering the work of the group. It was stipulated that the book be simple in form yet accurate in detail which would appeal to all those who wish to apply the results of this work and at the same time be not without appeal to the scientific worker in securing a continuance of the research effort.

The Committee has performed much valuable work and the author is to be complimented on the manner in which he has selected and arranged the material.

The investigations have had to do mainly with the rusting of iron and steel in the atmosphere and when immersed in sea water. While this type of information is of interest to the worker in the field of corrosion and in a practical manner to certain other groups it does not offer as great an appeal to the chemical engineer who is concerned with corrosion of process equipment by chemicals.

HANDBOOK OF MATHEMATICAL TABLES AND FORMULAS. Second Edition. Compiled by R. S. Burington. Published by Handbook Publishers, Inc., Sandusky, Ohio. 275 pages. Price $1.25.

CONTAINING the mathematical material, tables and formulas of Lange's well-known Handbook of Chemistry, this new edition presents much information in convenient form. Revision consists of enlargement of the tables of integrals and addition of values of $(10n)^{\frac{1}{2}}$, $(10n)^{\frac{1}{3}}$, and $(100n)^{\frac{1}{4}}$ to the tables of powers of numbers.

### NEAR ABSOLUTE ZERO

PHENOMENA AT THE TEMPERATURE OF LIQUID HELIUM. By *E. K. Burton, H. G. Smith* and *J. O. Wilhelm.* Published by Reinhold Publishing Corp., New York, N. Y. 362 pages. Price $6.

Reviewed by *H. J. Macintire*

THIS MONOGRAPH deals primarily with the physical properties of matter at temperatures as low as 4.2 deg. K. or less, but the authors have wandered freely outside this limited temperature near the absolute zero whenever it seemed necessary to do so. The first five chapters, dealing with a historical preface, methods of liquefaction of gases, the measurement of temperatures, the physical properties of liquid and solid helium and superconductivity (123 pages in all) are more or less an introduction. The remainder of the book deals with specific heats at low temperatures, magnetic properties, temperatures below 1 deg. K., electrical and thermal conductivities, the nature of the superconducting state and the λ-transformation in liquid helium.

The introductory chapters can be read by anyone to advantage, whereas the remainder of the book requires a knowledge of the principles of thermodynamics, a brief course in the quantum theory and some knowledge of theoretical physics. The text has numerous references to the bibliography at the end of each chapter and the material is well arranged. The book does the authors great credit.

This book will be of great interest to the chemist as well as the physicist. In fact, the modern electrical engineer will be interested in the freakish antics of liquid helium at temperatures below 2 deg. K.

WHALE OIL, AN ECONOMIC ANALYSIS. By *Karl Brandt.* Published by Food Research Institute, Stanford University, Calif. 264 pages. Price $3.

Reviewed by *G. W. McBride*

THIS BOOK is the seventh of a series of fats and oils studies begun in 1928 by the Food Research Institute. It tells about "the mighty whales which swim in a sea of water, and have a sea of oil swimming in them." Those who have read Moby Dick will find this volume a very interesting factual sequel.

The story of the rise, decline, and revival of whaling is presented in a very readable style. The principal reason for the recent revival of this international big business is the need for fats and oils in those lands which are unable to produce sufficient animal and vegetable oils, and which are also financially unable to purchase them in world markets. With the oceans free to all, this frontier presented opportunity to such nations as Japan and Germany particularly.

The modern whaling technique, and the transportation, storage, and marketing of whale oil are described. International competition in whaling, with the reasons for Norwegian predominance in this field, and international cooperation are also gone into at great length. Recent years have seen catches limited only by the number of whalers sent out. Considerable fear has been expressed by biologists that the supply of whales would soon be exhausted if whaling continued at the peak rates of the last decade. A considered estimate is made by the author that an annual whale oil production of about 400 to 500 thousand tons would not be excessive under peace-time conditions and with international cooperation. This compares with 614 thousand tons in 1930-31 and 606 thousand tons in 1937-38. That the catch is depleting the world supply of whales is evident from the fact that it required only 43 thousand whales to produce the 614 thousand tons of oil in 1930-31, but seven years later 55 thousand whales (younger and smaller) produced only 606 thousand tons of oil.

The international demand for whale oil will continue for its edible uses predominantly, although in this country it is used exclusively for soap. It is interesting to note in one of the charts of the book that whale oil leads all other fats and oils, in percent ad valorem, in duties and excise taxes actually paid on U. S. imports during the period 1931-35. The figure given is 130 per cent.

The last 50 pages of the book are devoted to 32 appendix tables, a ten-page bibliography, and a very helpful index. Thirty charts distributed throughout the entire volume serve as excellent illustrative matter, both for momentary reading and for their permanent reference value. Anyone interested in any phase of fats and oils utilization in this country should have a copy of this book.

### THE STORY OF SOAP

SOAP MANUFACTURE. By *J. H. Wigner.* Published by Chemical Publishing Co., Inc., New York, N. Y. 170 pages. Price $4.

ALTHOUGH WRITTEN for the non-technical operator in the soap industry, technical men not familiar with the soap industry will also find this book of interest and value. It explains in simple language the fundamental theories which lie behind the soap boiling and glycerin recovery operations of the soap plant. It tells the theoretical "why" and the practical "how" of many of the essential steps in soap manufacture, being at the same time useful both for guiding operations and for reference.

The author, as would be expected, uses English terminology rather than American, but the terms are understood with little difficulty in the few cases where this is noticed.

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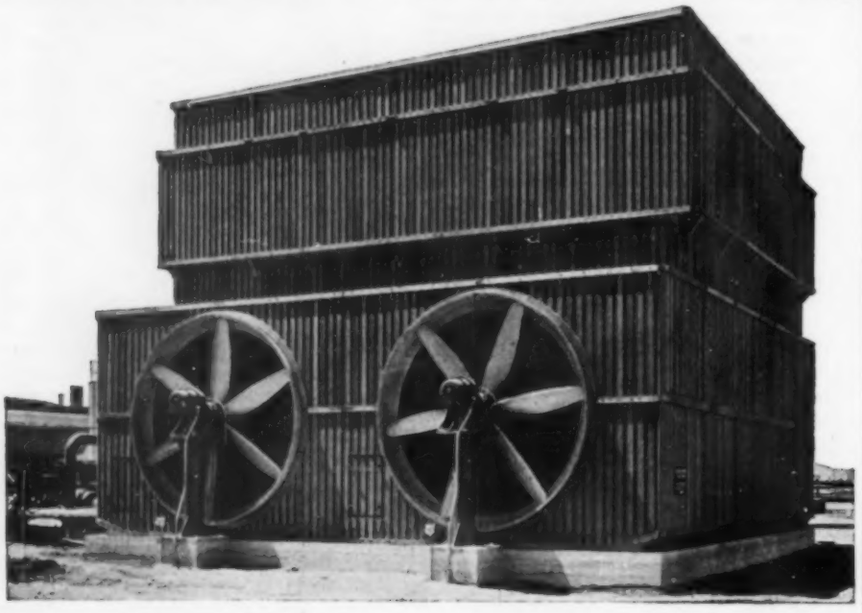

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in the appendix. These graphical methods of determining caustic soda requirements, glycerin and fatty acid yields, and other miscellaneous salt and glycerin relationships should also be helpful to the research man.

ELECTROCHEMISTRY AND ELECTROCHEMICAL ANALYSIS. Volume II. Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests. By *H. J. S. Sand.* Published by Blackie and Son, Glasgow. Available from the Chemical Publishing Co., New York, N. Y. 150 pages. Price $2.

Reviewed by *G. F. Kinney*

SECOND of a series of three volumes on electrochemistry, this small book gives laboratory details of apparatus and analytical determinations. Included are gravimetric electrolytic analyses, electrolytic separations using an auxiliary calomel electrode, methods of internal electrolysis, and short chapters on electrolytic micro-analysis and electrolytic Marsh tests. The author uses the personal approach and describes his experiments and results with many types of determinations and separations. He gives details of typical methods of analysis; brasses, bronzes, white metals, bismuth in fuse wire, traces of mercury in brass condenser tubing, traces of nickel in zinc, and so on. The Marsh test methods are used for the determination of arsenic, antimony and germanium by electrolytic reduction to their hydrides.

TECHNICAL ASSOCIATION PAPERS. Series XXIII. Edited by *R. G. Macdonald* and *V. F. Waters.* Published by the Technical Association of the Pulp and Paper Industry, New York, N. Y. 752 pages. Price $6.

CONSISTING of papers and addresses presented before the annual meeting of the Technical Association of the Pulp and Paper Industry, this annual publication contains reports of most of the technical progress made in the paper industry during 1939.

PRACTICAL LATEX WORK. By *H. J. Stern.* Published by Blackfriars Press, Ltd. Available from *India Rubber World*, New York, N. Y. 103 pages. Price $1.50.

BASED on a series of papers by the author in *The Rubber Age* (London), this small book discusses the raw material, preparing the mix, compounding ingredients, dipping methods and equipment, vulcanised latex, latex spreading, and costing in latex manufacture.

INORGANIC AND ANALYTICAL CHEMISTRY. By *Ernest J. Baldwin.* Published by D. Van Nostrand Co., New York, N. Y. 506 pages. Price $3.25.

INTENDED as a textbook for courses in second-year college chemistry, this volume is in two parts: properties of atoms and molecules, and theory of reactions. Starting with the gas laws, Part I continues with discussions of properties of liquids and vapors, the periodic classification, matter and

radiation, photochemistry, atomic structure, nuclear chemistry and other concepts of modern physical chemistry. Part II, applications to qualitative and quantitative analysis, considers reaction velocity and equilibrium, solutions of electrolytes, solution and precipitation, gravimetric analysis, oxidation-reduction reactions and other subjects pertaining to the two subdivisions of analytical chemistry.

Actually, it seems to us, the volume is really two textbooks in one; an elementary treatise on physical chemistry and a text on analysis. In use, one part will probably serve as reference material for the other. It will remain to be seen whether or not such a combination of textbooks will prove successful.

MR TOMPKINS IN WONDERLAND. By *G. Gamow*. Published by The Macmillan Co., New York, N. Y. 91 pages. Price $2.

MOST APPROPRIATELY, this little book is dedicated to Lewis Carroll and Niels Bohr; it contains both sense and nonsense. Prof. Gamow has attempted to clarify the theories of modern physics by transporting his readers to various imaginary countries and universes where the physical constants differ greatly from those of our world. In one country the speed of light is 10 miles per hour, in another the quantum constant is equal to 1 erg per second, and in a third universe of 200 miles diameter, the gravitational constant is $10^{13}$ times that on the earth. Explanations of the strange sights and events lead the reader painlessly to a clearer understanding of the theory of an expanding universe, of curved and finite space, and of some of the ideas of quantum mechanics.

Three quite serious lectures conclude the book. The fantasies in the first chapters are based on the material of these lectures. Studied after reading the nonsense, the sense will bring such ideas as curved space a little nearer to comprehension.

ELECTROCAPILLARITY. By *J. A. V. Butler*. Published by Chemical Publishing Co., New York, N. Y. 208 pages. Price $5.

Reviewed by *F. C. Nachod*

DR. BUTLER'S new book certainly has a baffling title, but as he points out in his preface "it has not been easy to find a concise title which would clearly indicate the scope and contents of this book." In more than 200 pages the "chemistry and physics of electrodes and other charged surfaces" is treated.

After a short historical introduction on galvanic cells, the reader finds an extraordinarily well written chapter on the thermodynamics of electrode potentials, containing tables of electrode potentials, heat of solution, entropies of metals and ions as well as standard electrode potentials in nonaqueous solvents such as alcohols and ammonia.

The following two chapters deal with the mechanism of reversible electrodes and electrical double layers.


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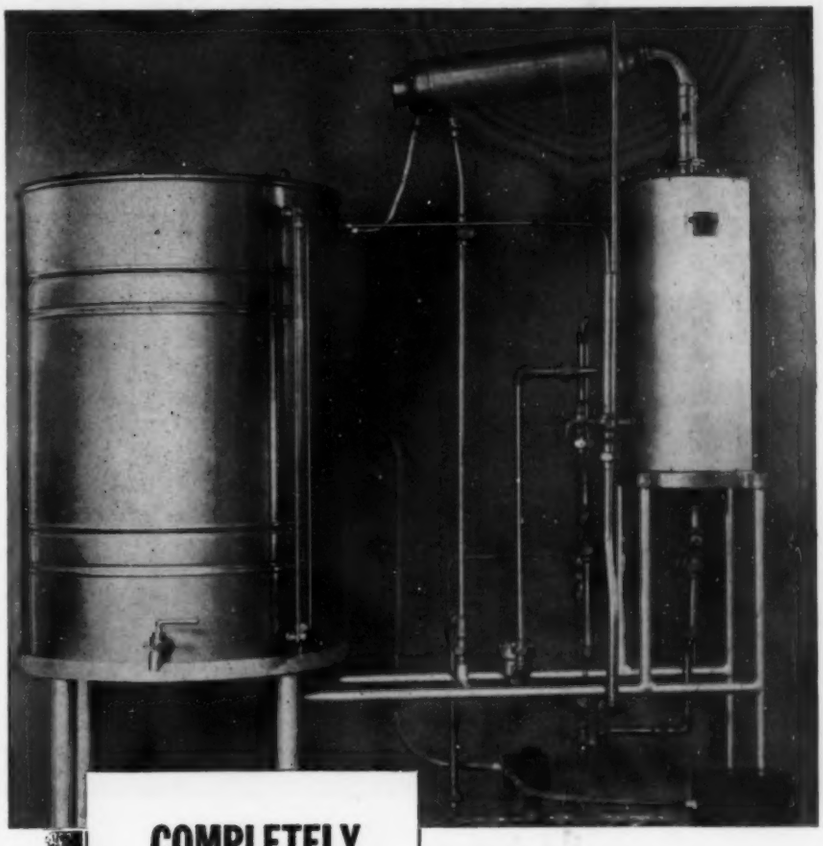

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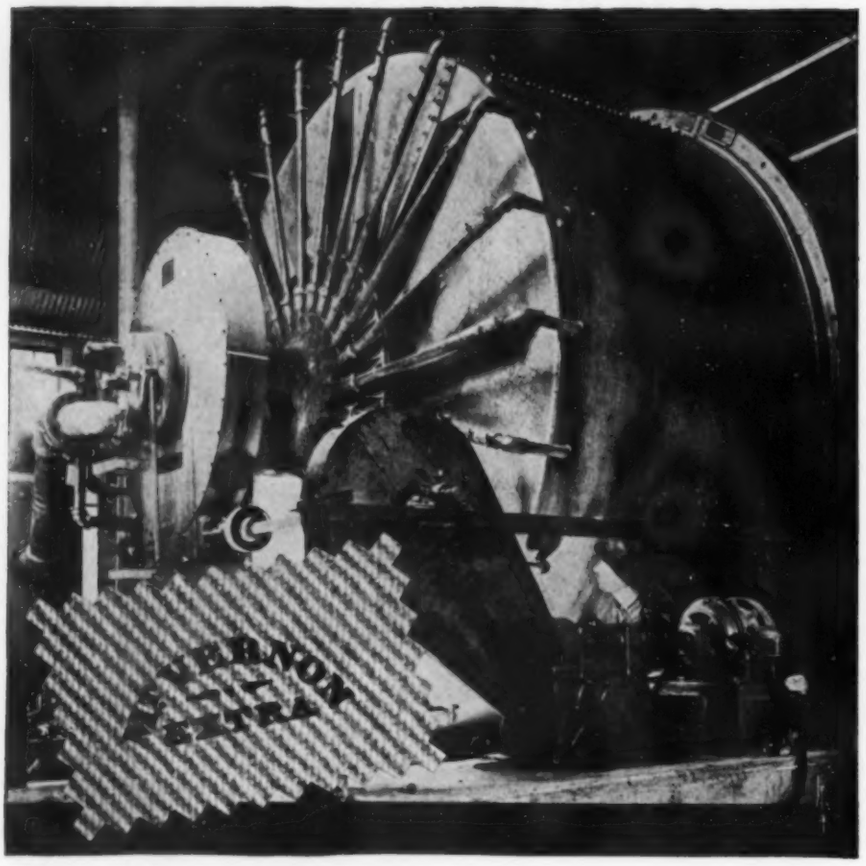

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Here the formation of complex ions and their influence on oxidation potentials, the dropping mercury electrode and adsorption phenomena are discussed.

Those who are not familiar with the paper of the New York Academy of Sciences on Electrophoresis (Nov. 1939) will find the description of the work of Longsworth and MacInnes, of Abramson, Müller and Kruyt on electrokinetic phenomena most useful.

Chapters on overvoltage, on concentration polarization and metal deposition and on some various electrode processes conclude the book. For further reading Dr. Abramson's "Electrokinetic Phenomena" is recommended by the author. The references at the bottom of each page are carefully selected. A good part of the reported work is the author's own research. The mathematical derivations and the notation are clear and elegant.

THE PHYSICAL SCIENCES. By *E. J. Cable, R. W. Getchell* and *W. H. Kadesch*. Published by Prentice-Hall, Inc., New York, N. Y. 754 pages. Price $5.

FROM A chemical engineering viewpoint, this book is unimportant. It is apparently intended as a text for survey courses in general science and as a popular introduction to that mysterious thing known to the layman as "Science." And it can be highly recommended to the serious student in either category. It deals, in elementary language, with the physical sciences: mechanics, physics, chemistry, geology and astronomy. The authors are equally at ease discussing calendar reform, methods of discovering hidden water supplies by means of divining rods, the inner workings of the cathode-ray television tube, or the chromophore groupings in dye molecules. Extensive references for further reading, questions on the material of the various chapters and a complete index conclude the book.

A NEW DICTIONARY OF CHEMISTRY. Edited by *Stephen Miall*. Published by Longmans, Green and Co., New York, N. Y. 575 pages. Price $15.

WITH THE cooperation and assistance of a number of well-known British chemists, the Editor of *Chemistry and Industry*, (London), has produced a book which is intended to supplement the existing treatises by providing in one volume a mass of miscellaneous information on chemical matters in general. The material in the dictionary covers a broad scope and the definitions are well written and easily readable. Many structural formulas are included which aid in presentation of data on organic compounds. A number of short biographical sketches are also included. The book concludes with a table giving physical constants of some 1,800 organic compounds. There are a few omissions of terms and compounds which should have been included. This will undoubtedly be corrected in subsequent editions.

In his introduction, the editor states that there has long been a need for a one-volume dictionary. He is apparently unaware of the existence of two such dictionaries published in this country; one edited by Hackh and Grant, the other by Bennett. Compared with these two books, Miall's has fewer pages and fewer entries. Definitions in the new book, however, are more complete. This is particularly true of organic compounds.

SPECIFIC AND SPECIAL REACTIONS FOR USE IN QUALITATIVE ANALYSIS. By *F. Feigl.* Available from Nordemann Publishing Co., New York, N. Y. 192 pages. Price $3.50.

FIRST English translation of the theoretical part of Feigl's complete German text on qualitative analysis, this volume presents familiar theoretical bases which are of peculiar significance in the special field of detection reactions. Among subjects discussed are types of complex compounds, masking of reactions, enhancement of reactivity, effect of certain atomic groupings, weighting effects, capillary phenomena and fluorescence analysis. It will pay those using "Spot Tests" (*Chem. & Met.*, March 1940, p. 202) to study this volume because, as the author points out in his introductory chapter, analytical chemistry is much more than a mere collection and orderly arrangement of recipes.

CHEMICAL INDUSTRIES, 1940. Edited by *D. M. Newill.* Published by Leonard Hill, London. Distributed by Chemical Publishing Co., New York, N. Y. Price $4.

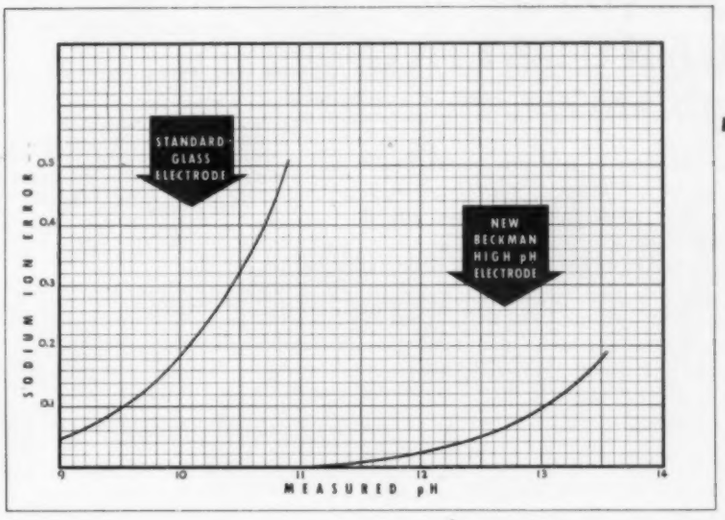
WAR ECONOMIES may have necessitated the inferior grade of paper used in some sections of this British book, but there has been no apparent curtailment of the contents. Containing a large quantity of useful chemical and chemical engineering data, the book is a practical aid to chemical manufacturers and chemical engineers. The catalog sections will, perhaps, be of minor interest to American users.

MODERN EXPORT PACKING—1940. By *Joseph Leeming.* Issued by Bureau of Foreign and Domestic Commerce as Trade Promotion Series No. 207. Available from Superintendent of Documents, Washington, D. C. 530 pages. Price $1 (cloth).

THIS VOLUME is a composite of shipping instructions which have been assembled by the author with the assistance of a considerable number of trade associations and industrial specialists, including the packaging technicians of the Forest Products Laboratory. Various chapters relate to construction of containers, crates and crating, plywood boxes, wire-bound containers, fiberboard containers, bales, barrels, drums, etc. There are also chapters on suggested methods for packing of different commodity groups ranging from abrasives alphabetically through wood manufactures. The book is an inexpensive and valuable guide.


*Another*

**BECKMAN ACHIEVEMENT**

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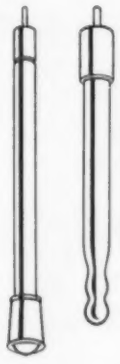

***The new Beckman Type E Electrode, on the other hand, requires no correction whatever at pH 11 and is accurate to within .2 pH at values as high as 13.5 pH where ordinary glass electrodes are useless under these conditions.***

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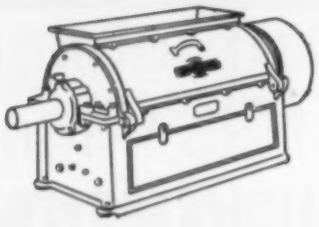

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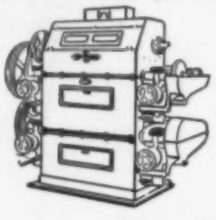

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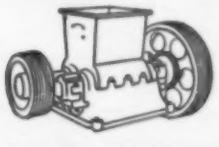

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# GOVERNMENT PUBLICATIONS

*Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.*

**Permanence and Durability of Paper,** by Morris S. Kantrowitz, Ernest W. Spencer, Robert H. Simmons. An annotated bibliography of the technical literature from 1885 to 1939. U. S. Government Printing Office, Technical Bulletin No. 22; 15 cents.

**Port and Terminal Charges at United States Sea Ports, 1940 edition.** War Department, Corps of Engineers, Miscellaneous Series No. 1; $1.

**Ivy and Sumac Poisoning.** U. S. Public Health Service, Supplement No. 161 to Public Health Reports; 5 cents.

**Safety Rules for the Installation and Maintenance of Electrical Supply Stations, Comprising Part I and the Grounding Rules of the Fifth Edition, National Electrical Safety Code.** National Bureau of Standards, Handbook H31; 10 cents.

**Commercial Standards and Their Value to Business.** (Third Edition.) National Bureau of Standards, Commercial Standard CSO-40. Available only from Division of Trade Standards, National Bureau of Standards, Washington, D. C.

**Pipe Nipples; Brass, Copper, Steel and Wrought-Iron.** National Bureau of Standards, Commercial Standard CS5-40; 5 cents.

**Sources of Information on the Properties of Metals and Alloys.** (Books.) National Bureau of Standards, Letter Circular LC601; mimeographed.

**Census of Manufactures: 1939.** The preliminary mimeographed figures compiled from returns of the Census of Manufactures, 1939, are now beginning to appear. Among the first of these to be released is "Matches." Others will follow from time to time during the next few months. Available from Bureau of the Census, Washington, D. C.

**The Detection and Relief of Case-hardening.** Forest Products Laboratory, Technical Note No. 213. Available only from Forest Products Laboratory, Madison, Wisconsin.

**Recent Developments in the Chemical Utilization of Wood,** by C. P. Winslow. Available only from Forest Products Laboratory, Madison, Wisconsin.

**Proximate Composition of American Food Materials,** by Charlotte Chatfield and Georgian Adams. U. S. Department of Agriculture, Circular No. 549; 15 cents.

**Administrative Instructions Amending Authorization of the Shipment of Fruits and Vegetables from Hawaii to the Mainland Subject to Fumigation with Methyl Bromide under Supervision.** U. S. Department of Agriculture, Bureau of Entomology & Plant Quarantine, B. E. P. Q. 510; mimeographed.

**Foreign Trade of Latin America.** The U. S. Tariff Commission has recently issued the following reports: Graphic Analysis of the Trade of Latin America; Part II. Commercial Policies and Trade Relations of Individual Latin American Countries, Section 1 (Argentine) and Section 3 (Brazil); Part III, Selected Latin American Export Commodities, Volumes 1 and 2.

**Statistics of Production, Sales, Imports, and Exports of Coal-Tar Crudes, 1938 and 1939.** U. S. Tariff Commission unnumbered document; mimeographed.

**Our National Resources—Facts and Problems.** National Resources Planning Board; 10 cents.

**Regional Planning, Part IX—The Northern Great Plains.** National Resources Planning Board; 10 cents.

**Trends and Seasonal Variations in Factors Influencing Domestic Motor-Fuel Demand,** by Herbert A. Breakey. U. S. Bureau of Mines, Economic Paper 21; 10 cents.

**Petroleum Statistics, 1935–38,** by G. R. Hopkins. U. S. Bureau of Mines, Economic Paper 20; 10 cents.

**Mechanical Shoveling in Underground Metal Mines,** by McHenry Mosier and J. H. Steinmesch. Bureau of Mines, Bulletin 423; 25 cents.

**Coal-Mine Accidents in the United States: 1937,** by W. W. Adams, L. E. Geyer, and M. G. Parry. Bureau of Mines, Bulletin 430; 15 cents.

**Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1940,** by G. R. Hopkins and E. W. Cochrane. U. S. Bureau of Mines, Information Circular 7124; mimeographed.

**Possibilities of Manganese Production at Leadville, Colo.,** by J. H. Hedges. U. S. Bureau of Mines, Information Circular 7125; mimeographed.

**Determination of Total Water-Soluble Chlorides in Petroleum,** by J. W. Horne and Lloyd F. Christianson. U. S. Bureau of Mines, Report of Investigations 3517; mimeographed.

**Ore-Testing Studies—Primarily Precious Metals,** by Edmund S. Leaver, Jesse A. Woolf, and A. P. Towne. U. S. Bureau of Mines, Report of Investigations 3515; mimeographed.

**Novel Device for Collecting Air Samples in Inaccessible Places,** by W. J. Fene. U. S. Bureau of Mines, Information Circular 7122; mimeographed.

**Cooperative Fuel Research Motor-Gasoline Survey, Winter 1939-40,** by E. C. Lane. U. S. Bureau of Mines, Report of Investigations 3524; mimeographed.

**Quantitative Analysis by X-Ray Diffraction, 1. Determination of Quartz,** by James W. Ballard, H. I. Oshry, and H. H. Schrenk. Bureau of Mines, Report of Investigations 3520; mimeographed.

**Onyx Marble and Travertine,** by Oliver Bowles. U. S. Bureau of Mines, Information Circular 6751-R; mimeographed.

**Beneficiation of Boron Minerals by Flotation as Boric Acid,** by R. G. Knickerbocker and F. K. Shelton. Production of Calcium Borate from Colemanite by Carbonic Acid Leach, by R. G. Knickerbocker, A. L. Fox, and L. A. Yerkes. These two reports are contained in U. S. Bureau of Mines Report of Investigations 3525; mimeographed.

**Minerals Used in Welding,** by Oliver C. Ralston and M. N. von Bernewitz. U. S. Bureau of Mines, Information Circular 7121; mimeographed.

**Staining of Clay Minerals as a Rapid Means of Identification in Natural and Beneficiated Products,** by George T. Faust. U. S. Bureau of Mines, Report of Investigations 3522; mimeographed.

**Natural-Gasoline Plants in the United States, January 1, 1940,** by G. R. Hopkins and E. M. Seeley. U. S. Bureau of Mines, Information Circular 7126; mimeographed.

**Methods of Sampling and Analyzing Coal-Mine Dusts for Incombustible Content,** by C. W. Owings, W. A. Selvig, and H. P. Greenwald. U. S. Bureau of Mines, Information Circular 7113; mimeographed.

**1940 Supplement—Survey of Current Business.** The annual supplement giving monthly data on production, trade, prices, national income, etc., as far back, in some instances, as 1913. Bureau of Foreign and Domestic Commerce; 40 cents.

**New Federal Reserve Index of Industrial Production.** Reprinted from Federal Reserve Bulletin for August 1940. Available from Board of Governors, Federal Reserve System, Washington, D. C.

**Code of Federal Regulations of the United States of America Having General Applicability and Legal Effect in Force June 1, 1938.** Title 36, Parks and Forests; Title 37, Patents and Copyrights; Title 38, Pensions, Bonuses, and Veteran's Relief; Title 39, Postal Service; Title 40, Prisons; Title 41, Public Contracts. National Archives; $2.25 for the clothbound volume.

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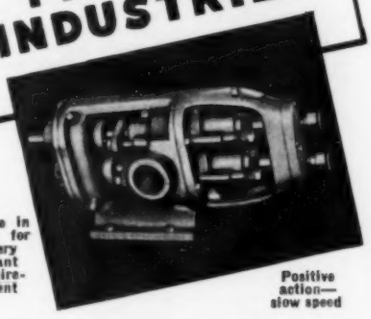

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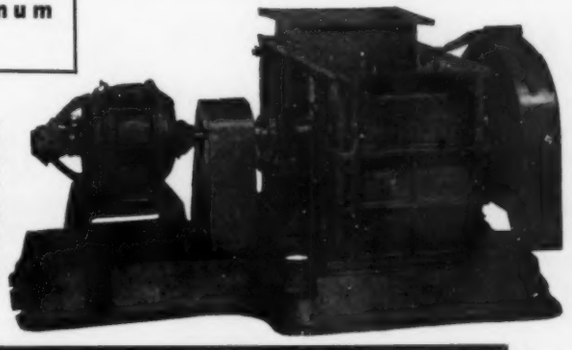

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# MANUFACTURERS' LATEST PUBLICATIONS

*Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.*

**Air Cleaning.** American Air Filter Co., Louisville, Ky.—Bulletin 250-C—16 pages describing this company's model C self-cleaning air filter with combined electrostatic precipitation, describing advantages, construction, efficiency, safety features, specifications and installation.

**Air Conditioning.** Carrier Corp., Syracuse, N. Y.—Bulletin AC-129—16 pages giving brief specifications on this company's complete line of equipment for air conditioning, refrigeration and heating; also leaflet describing this company's standard test laboratory air conditioner.

**Air Wrenches.** Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.—Bulletins CT344-R, CT349-R and CT360-R—2-page leaflets covering ⅜, ½ and ¾ in. bolt size reversible air-operated wrenches of a new design.

**Alloys.** Ferrous Metals Corp., New York, N. Y.—10 pages on Z-metal ductile alloy cast iron, with information on physical properties, applications, structure, corrosion information and production methods.

**Alloys.** Monsanto Chemical Co., St. Louis, Mo.—Bulletin 3—56-page book abstracting U. S. Patents relating to prosphorus as an alloy element in steel, also listing iron and steel patents.

**Ball Bearings.** New Departure Div., General Motors Corp., Bristol, Conn.—Bulletin A-20—16 pages discussing in detail the lubrication of this company's ball bearings, giving lubricant specifications and lubrication methods for particular cases.

**Bag Closing.** Bemis Bros. Bag Co., 601 South 4th St., St. Louis, Mo.—4-page leaflet describing the Super-Looper, a portable, friction-driven, non-electric bag closer for sewing cotton, burlap and certain types of paper bags.

**Blowers.** Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B-6048—24 pages on single-stage Turbo-Blowers with description, engineering data, construction features and application information.

**Carbon Black.** Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass.—12-page booklet on carbon black, covering largely in pictures the production and uses of carbon black and describing this company's "camp" at Kermit, Texas.

**Chemicals.** The Beacon Co., 89 Bickford St., Boston, Mass.—4-page leaflet giving list prices on stearates and other metallic soaps manufactured by this company.

**Chemicals.** Carbide & Carbon Chemicals Corp., 30 East 42d St., New York, N. Y.—New folder on synthetic alcohols describing 12 members of the alcohol group and giving properties and uses of each.

**Chemicals.** Hercules Powder Co., Wilmington, Del.—4-page reprint entitled "Have You Asked Hercules?" briefly describing ten interesting developments of this company.

**Chemicals.** Lanaetex Products Sales Corp., Box 52, Station A, Elizabeth, N. J.—4-page leaflet on lanolin and wool fats of various grades, briefly describing uses in various industries.

**Chemicals.** Paragon Testing Laboratories, Orange, N. J.—List No. 2.—34 pages on fine organic chemicals supplied by this company, giving names, sizes of package and list prices.

**Compressors.** Schramm, Inc., West Chester, Pa.—Folder briefly describing this company's Model 60 V-type, self-powered, stationary air compressors for 60 c.f.m. at 100 lb. pressure.

**Condensers.** Heat Exchange Institute, 90 West St., New York, N. Y.—"Typical Specifications for Surface Condensers and Auxiliaries for Turbine Service," designed to guide purchasers of surface condensers. Available at 25 cents from the Institute or included with "Standards of the Condenser Section," priced at $1.

**Electrical Equipment.** Heinemann Circuit Breaker Co., Trenton, N. J.—Catalog 40—36-page book on this company's time delay and instantaneous type magnetic circuit breakers of single, double and triple pole types.

**Electrical Equipment.** Ohmite Mfg. Co., 4835 West Flournoy St., Chicago, Ill.—Catalog 40—96 pages on this company's resistors, rheostats and tap switches, covering many types, with detailed descriptions and specifications. Includes extensive section on resistance measurements and engineering information.

**Electrical Equipment.** Roller-Smith Co., 1766 West Market St., Bethlehem, Pa.—Catalog 1230—8 pages describing this company's low-voltage, metal-inclosed air circuit breaker switching equipment.

**Electrical Equipment.** Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh, Pa.—Catalog Section 43-205—16 pages on rectangular-case switchboard instruments for flush and projection mounting.

**Engines.** Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Bulletin S-500-B38, 8 pages describing totally inclosed, four-cycle, direct-injection diesel engines: S-500-B-39, 4 pages on convertible gas diesel engines.

**Equipment.** Cochrane Corp., 17th and Allegheny Aves., Philadelphia, Pa.—Publications as follows: Publ. 2935, 8 pages describing this company's high-capacity, high-pressure dischargers for condensate; Publ. 2939, 10 pages on float-operated liquid-level controllers with pilot actuated regulating valves.

**Equipment.** The Dorr Co., 570 Lexington Ave., New York, N. Y.—Bulletin 7001—8-page booklet on this company's processing equipment, describing agitators, slakers, classifiers, hydroseparators, sizers, sand washers, thickeners and water treatment equipment.

**Equipment.** Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Publications as follows: Folder 1877, discusses screens for removal of solids from liquids; Book 1519-A, describes this company's complete line of herringbone-gear speed reducers.

**Equipment.** Schwarz Laboratories, 202 East 44th St., New York, N. Y.—12 pages on stainless steel apparatus developed by this company for the production of pure yeast cultures for brewing.

**Feeders.** International Filter Co., 325 West 25th Place, Chicago, Ill.—Bulletin 302—4 pages giving a detailed description of this company's Type MCO chemical solution feeders for water and sewage treatment, employing constant-head, variable-orifice discharge.

**Feeders.** Proportioneers, Inc., 9 Codding St., Providence, R. I.—Bulletin WAT—4-page leaflet describing methods of hypochlorination of water with this company's equipment of various types, with further information on ammoniation and superchlorination. This bulletin is available in Spanish as Bulletin SPN.

**Feeders.** Milton Roy Pumps, 3162 Kensington Ave., Philadelphia, Pa.—Leaflet briefly describing range of types of chemical proportioning pumps produced by this company with summary of features and advantages.

**Filters.** Combustion Engineering Co., 200 Madison Ave., New York, N. Y.—Catalog MR-4—16 pages on this company's Type MRO multiple retort stokers, describing construction, operation and principal features, together with information on typical installations.

**Finishes.** Heresite & Chemical Co., Manitowoc, Wis.—16-page booklet "The Story of Heresite," dealing with this company's synthetic plastic base finishes for corrosion resistance and their applications. Also discusses plastic molding compounds made by this company.

**Flashlights.** Ideal Commutator Dresser Co., 1264 Park Ave., Sycamore, Ill.—2-page leaflet describing this company's storage batteries for flashlights, together with charging equipment for batteries.

**Furniture.** Penn Metal Corp. of Penna., 36 Oregon Ave., Philadelphia, Pa.—Booklet 44, Series A—28 pages giving detailed specifications and prices on heavy-gage steel lockers, cabinets and shelving made by this company.

**Heating.** Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin HD-740—6 pages describing this company's radiant heat electric furnace heating elements, with information on types of furnaces and details of construction.

**Hose.** Sullivan Machinery Co., Michigan City, Ind.—Bulletin 87-Z—Describes hose for pneumatic tools, suction hose and combination air and water hose.

**Instruments.** Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio—Bulletin 107-A—16 pages on this company's controls for pressure reducing and desuperheating, describing equipment involved and principles, and listing users.

**Instruments.** The Foxboro Co., Foxboro, Mass. — DMF1376 — Brief case studies of industrial results of the use of this company's measuring and control instruments.

**Lubrication.** E. F. Houghton & Co., 3d, American and Somerset Sts., Philadelphia, Pa.—4-page leaflet describing advantages of this company's Sta-Put lubricants for lubrication of electric motors.

**Magnetic Brakes.** Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 604—12 pages discussing completely this company's magnetic disk brakes, with specifications, description and installation information.

**Maintenance Painting.** Industrial Paint Clinic, 43 East Ohio St., Chicago, Ill.—128-page "Maintenance Painting Handbook," a compendium of solutions to difficult industrial painting problems published by the Industrial Paint Clinic of the American-Marietta Co. This guide is said to represent the accumulation of reports and records of technical paint questions extending over a period of 27 years, being boiled down from 100,000 actual cases and carefully indexed for quick reference. Covers surface preparation, methods of paint application, types of paints for particular conditions, etc.

**Materials Handling.** All Steel Welded Truck Corp., Rockford, Ill.—8 pages describing this company's semi-live-skid materials handling system, illustrating numerous specialized types of skid truck offered by this company.

**Materials Handling.** Cleveland Tramrail Div., The Cleveland Crane & Engineering Co., Wickliffe, Ohio—Form 2004-A—12 pages on how to determine where overhead materials handling equipment can be used profitably, with information on types of application and materials handling layouts.

**Metal Spraying.** Metallizing Engineering Co., 21-07 41st Ave., Long Island City, N. Y.—Vol. 1, No. 1 of Metco News, a new periodical devoted to latest developments and applications of metal spraying.

**Ovens.** Precision Scientific Co., 1750 North Springfield Ave., Chicago, Ill.—Bulletin 315—24 pages giving detailed specifications and performance data on this company's wide range of thermostatically controlled electrically heated laboratory ovens with gravity and mechanical convection heat transfer.


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| "MULTILEAVES" | Improved type for filter presses |
| "B.W.D" | (Filter Leaves) for better drainage and cleaning |
| "SINGLEDISCS" | Up to 25 ft. diam. for claytowers, percolators, waterfilters, etc. |
| "SMOOTHTEX" | Metallic filter cloth, twilled dutch type |
| "MULTIBRAID" | Metallic filter cloth, twilled braided type |
| "SMOOTHBOLT" | Metallic bolting cloth, for fine sifting |
| "HI-RATIO" | Screens—Long mesh, large open area |
| "RIBTEX" | Screens—Re-enforced long mesh |
| "DRUMTITE" | Re-enforced binders for vibrating screens |
| "WELDEDGE" | Flexible metallic binding |

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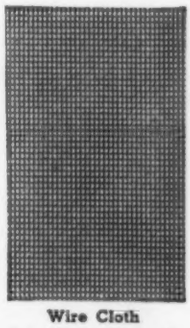

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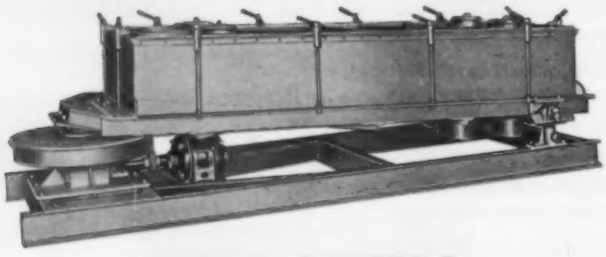
ALL METALS

# Here are some of the MACHINES →→→→→



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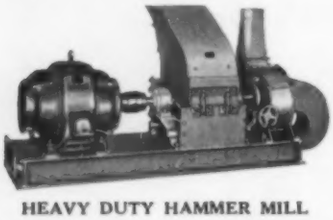

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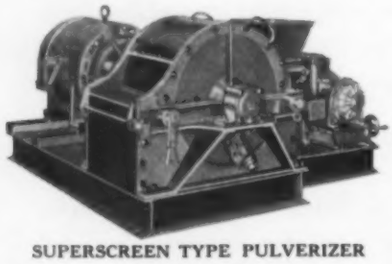

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Especially suitable for single pass reduction of many materials without the use of auxiliary separators, fans or collectors. Product from the mill passes through *dust tight* spouts direct to conveyors or containers. Write for full details.

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**MUNCY, PA.**


**Paint.** The Wood Preserving Corp., Koppers Bldg., Pittsburgh, Pa.—Leaflet describing methods for satisfactorily painting creosoted wood.

**pH Measurement.** Paul Frank, 456 Fourth Ave., New York, N. Y.—4-page leaflet describing pH test papers, with information on advantages, accuracy, ranges covered and specialized pH papers.

**Power Transmission.** Ajax Flexible Coupling Co., Westfield, N. Y.—New 20-page data book on this company's Ajax flexible couplings, with specifications and engineering data in form suitable for design and maintenance work.

**Power Transmission.** Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B-6051-A—16 pages on this company's Texrope V-belt drives, giving information on advantages, applications, construction features and selection.

**Power Transmission.** Boston Gear Works, Hancock & Hayward Sts., North Quincy, Mass.—8-page booklet on Hardware Products Co. machine parts distributed by this company, including crown face and V-groove pulleys, pillow boxes, shaft supports and couplings. Also Form 1-39, 16-page booklet on Oilite bronze bearings, also distributed by this company and folder A-40 covering sizes, prices and specifications of Oilite solid and cored bar stock, plate and strip stock.

**Power Transmission.** Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Catalog 1845—12 pages on this company's complete line of flexible couplings, giving prices and dimensional data.

**Power Transmission.** Worthington Pump & Machinery Corp., Harrison, N. J.—72-page manual on this company's multiple-V-belt drives, with simplified information on selection and information on sheaves and on V-belt operation.

**Proportioners.** Cochrane Corp., 17th and Allegeny Aves., Philadelphia, Pa.—Publication 2985—4 pages describing this company's proportioning equipment for corrosive liquids, with information on construction, operation and advantages.

**Proportioners.** Milton Roy Pumps, 3160 Kensington Ave., Philadelphia, Pa.—Three new proportional feed diagrams dealing with feeding of water treating chemicals to boilers are now available in addition to three earlier diagrams already announced; these are 8½x11 diagrams for filing or binding.

**Pulp Treatment.** Wallace & Tiernan Co., Newark, N. J.—Technical Reprint 432—52-page illustrated book on microbiological control in pulp and paper manufacture, assembling in one cover reprints on three phases of this subject important to paper mill operators.

**Pumps.** DeLaval Steam Turbine Co., Trenton, N. J.—Catalog L-32-A—12 pages describing this company's IMO pumps, Series A-32, particularly with reference to their use in oil pumping. Also leaflet describing several methods of automatic priming for this company's centrifugal pumps.

**Regulators.** The Foster Engineering Co., 109 Monroe St., Newark, N. J.—Bulletin 11—16-page booklet on this company's Type T temperature regulators for steam, air, liquids and gases, with detailed construction information and data on installation and applications.

**Screens.** J. H. Day Co., Cincinnati, Ohio—Folder 376—4 pages describing and giving specifications on this company's Ro-Ball gyrating screens.

**Separators.** Yale Oil Separator Co., 405 Lexington Ave., New York, N. Y.—8-page leaflet describing this company's automatic gravity separator for non-miscible liquids of different specific gravities.

**Sewage Treatment.** Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Folder 1881—Discusses bio-filtration sewage treatment.

**Shipping.** Acme Steel Co., 2840 Archer Ave., Chicago, Ill.—Form AD 18—8

pages describing this company's skid-load process for assembling shipping packages, showing many typical applications.

**Thickeners.** Hardinge Co., York, Pa. —Bulletin 31-C—Describes in detail this company's Auto-Raise thickener with further information on clarifiers, agitators and hydroclassifiers.

**Traps.** W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.—Bulletin 740—4 pages describing this company's new Model C weight-operated traps for steam, air and gasoline for high pressure and high temperature.

**Water Softening.** Elgin Softener Corp., Elgin, Ill.—Leaflet describing a new method recently developed by this company for increasing capacity of zeolite water softening systems, known as the "Double-Check" system.

**Water Treatment.** The Permutit Co., 330 West 42d St., New York, N. Y.—Bulletin 2341—32 pages describing in detail this company's hot process water softener, with sections devoted to chemistry of water softening and corrective treatment, and to equipment and auxiliaries.

**Weights.** Christian Becker, Inc., 92 Reade St., New York, N. Y.—Catalog 665—16 pages on this company's precision weights for analytical, assay and other balances.

**Whiteprints.** Ozalid Corp., Johnson City, N. Y.—8-page folder describing in detail this company's new Model F fast-printing whiteprint machine.

**Zinc.** St. Joseph Lead Co., 250 Park Ave., New York, N. Y.—24-page booklet, "The Story of St. Joe Electro Thermic Zinc," giving zinc statistics and a pictorial story of the production of zinc by this company from ore to metal.

## EQUIPMENT BRIEFS

(*Continued from page 636*)

long-fiber asbestos combined with suitable bonding agents, the new packing is intended for flange and joint packing for superheated and saturated steam at high pressures and temperatures, and for air, ammonia, gases, oils, gasoline and most chemicals.

THROUGH USE of a construction yielding high strength and rigidity, light-gage steel is employed in a new line of steel pallets for fork lift trucks and hand pallet trucks, which has been put on the market by the Union Metal Manufacturing Co., Canton, Ohio. These pallets are formed by welding corrugated cross members to channel members which are shaped to take the corrugations. Such a pallet, constructed of 14-ga. steel and designed for 4,000 lb. load, was recently loaded with 55,000 lb., according to the manufacturer, without failure.

SEVERAL ADVANCES in design are said to be incorporated in the new Model 2 Explosimeter combustible gas indicator recently perfected by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa. A simplified electrical circuit featuring a single filament and single control knob is used, for one-hand operation. Standard flash-light batteries are used, and a low-cost replaceable filament having a usual life said to be several thousand tests. The instrument weighs but 4½ lb. without carrying straps.


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Kindly send particulars on your equipment

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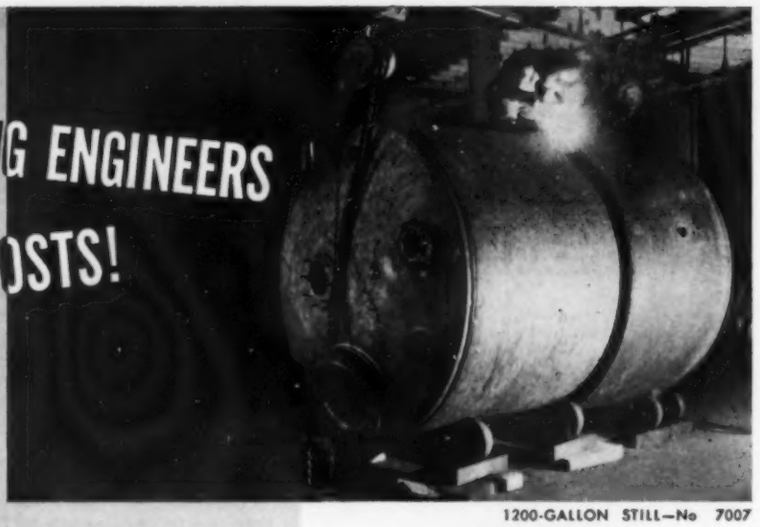
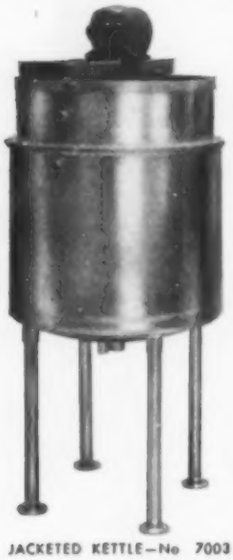
# HOW MODERN PROCESSING ENGINEERS BANISH REPLACEMENT COSTS!



1200-GALLON STILL—No 7007

AGITATED KETTLE—No 7000



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**. . . Stainless Steel Equipment of All-rounded Construction Eliminates Maintenance Cost and Assures More Profitable Operation.**

● Economy-minded processing engineers demand equipment with easy-to-clean corners, large spherical coves and welds ground to a smooth, invisible finish. This modern construction practically eliminates replacement costs and has proven to be "dollars" ahead of other equipment built according to out-moded standards.

S. Blickman, Inc., with one of the country's most modern plants, makes this equipment in the one-thousand-and-one odd shapes required by the processing industries.

Power squaring shears that cut accurately to within .005", 250-ton presses, power brakes, special-purpose welding and grinding machinery and a factory staff with welders qualified to do A.S.M.E. code welding — all are on hand to build profit-making equipment to your requirements.

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LIQUID HANDLING TRUCK
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MIXER with SPIRAL AGITATOR

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# CONSUMPTION OF CHEMICALS MAINTAINED ON STEADY LEVEL IN LAST TWO MONTHS

Chem & Met ECONOMICS and MARKETS

REPORTS regarding activities in manufacturing industries during August indicate that consumption of chemicals gained in volume in the iron and steel, textile, coal products, leather, and explosives branches but was reduced in the paper, paint and varnish, and petroleum branches. The preliminary index for chemical consumption in August is 137 which compares with a revised figure of 136.24 for July. The indexes for August and July 1939 were 123.23 and 111.41 respectively. The comparatively steady rate of consumption maintained in the last two months promises to give way to an accelerated pace in the coming months, as early September reports credited enlarged operations in different manufacturing lines. The stimulus of the defense program is making itself manifest. For instance, government orders for woolen goods will alone suffice to keep mills moving at a fairly high level over the remainder of the year while demand for steel promises to push production rates beyond the record levels reached in the latter part of last year. Glass mills are recovering from the usual summer slowness although a surprisingly large output of containers was reported for July. The tanning trade which has lagged for the greater part of the year to date has reversed its position and is on an upward curve.

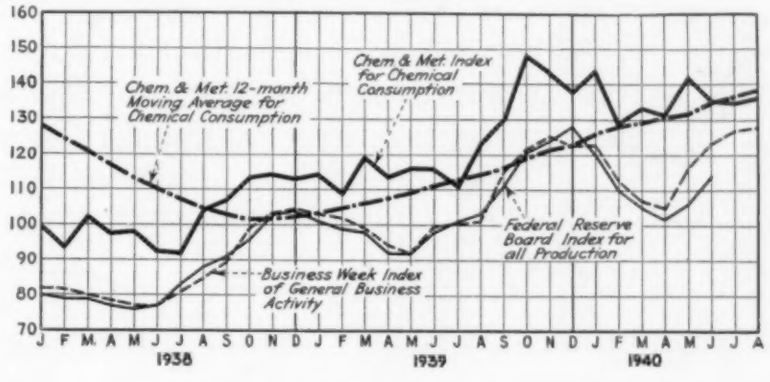
**Chem. and Met. Index for Consumption of Chemicals**

| | June Revised | July |
|---|---|---|
| Fertilizer | 26.05 | 26.10 |
| Pulp and paper | 21.60 | 19.40 |
| Petroleum refining | 14.22 | 14.28 |
| Glass | 11.94 | 11.61 |
| Paint and varnish | 12.25 | 11.20 |
| Iron and steel | 10.86 | 11.26 |
| Rayon | 11.43 | 11.44 |
| Textiles | 7.13 | 7.77 |
| Coal products | 8.73 | 9.06 |
| Leather | 3.59 | 3.94 |
| Explosives | 4.80 | 4.87 |
| Rubber | 2.82 | 2.71 |
| Plastics | 2.64 | 2.60 |
| | 138.04 | 136.24 |

The Department of Commerce reports a slight rise in general inventories for July represented by the number 108.7 as compared with 108.2 for June, thus indicating an increase of 8.7 per cent from January as the figure for that month was 100. Statistics for stocks in the chemical producing and consuming industries are not plentiful but stocks of denatured alcohol were placed at 1,173 thousand gallons at the beginning of this year and at 1,662 thousand gallons on June 30. Figures for a few other products are available for the same period and include: glass containers, 9,237 thousand gross on Jan. 1 and 9,180 thousand gross on June 30; wood pulp, 123,600 tons on Jan. 1 and 165,200 tons on June 30; cotton at mills, 1,811 bales on Jan. 1 and 1,101 bales on June 30; steel barrels, heavy type, 61,251 on Jan. 1 and 46,776 on June 30; and reclaimed rubber, 25,250 tons on Jan. 1 and 28,327 tons on June 30.

Changes in our foreign trade are having a two-fold effect upon production of chemicals. For instance, import figures reveal that there has been some drop in arrivals of pyrites from foreign sources of supply. As domestic production of sulphuric acid has been running considerably above that for the corresponding period of last year, it is evident that either the domestic output of pyrites has been speeded up or a larger relative part of acid production is coming from sulphur, although it is admitted that some acid makers had large stocks of pyrites on hand. Chemical production also has been helped by the fact that our enlarged export trade has consisted of many finished products for which chemicals are necessary raw materials. As more and more foreign markets were cut off from water communication with this country, domestic production of many products was increased in order to make up for the reduction of foreign offerings.

Export trade in chemicals and related products has been well maintained judging from the figures for July. Outward shipments of such products, as included in Group 8 classification of the Department of Commerce, reached a value of $22,312,894 in July. Industrial chemicals held first place in the month's trade and were valued at $5,067,152. Exports of explosives, which had been relatively small up to June, were again of large volume in July and were valued at $4,629,350. Smokeless powder accounted for a large part of this total, the figures being 8,154,619 lb. valued at $3,477,584 while the seven months exports of this product were 11,924,293 lb. valued at $5,222,863.


160
150
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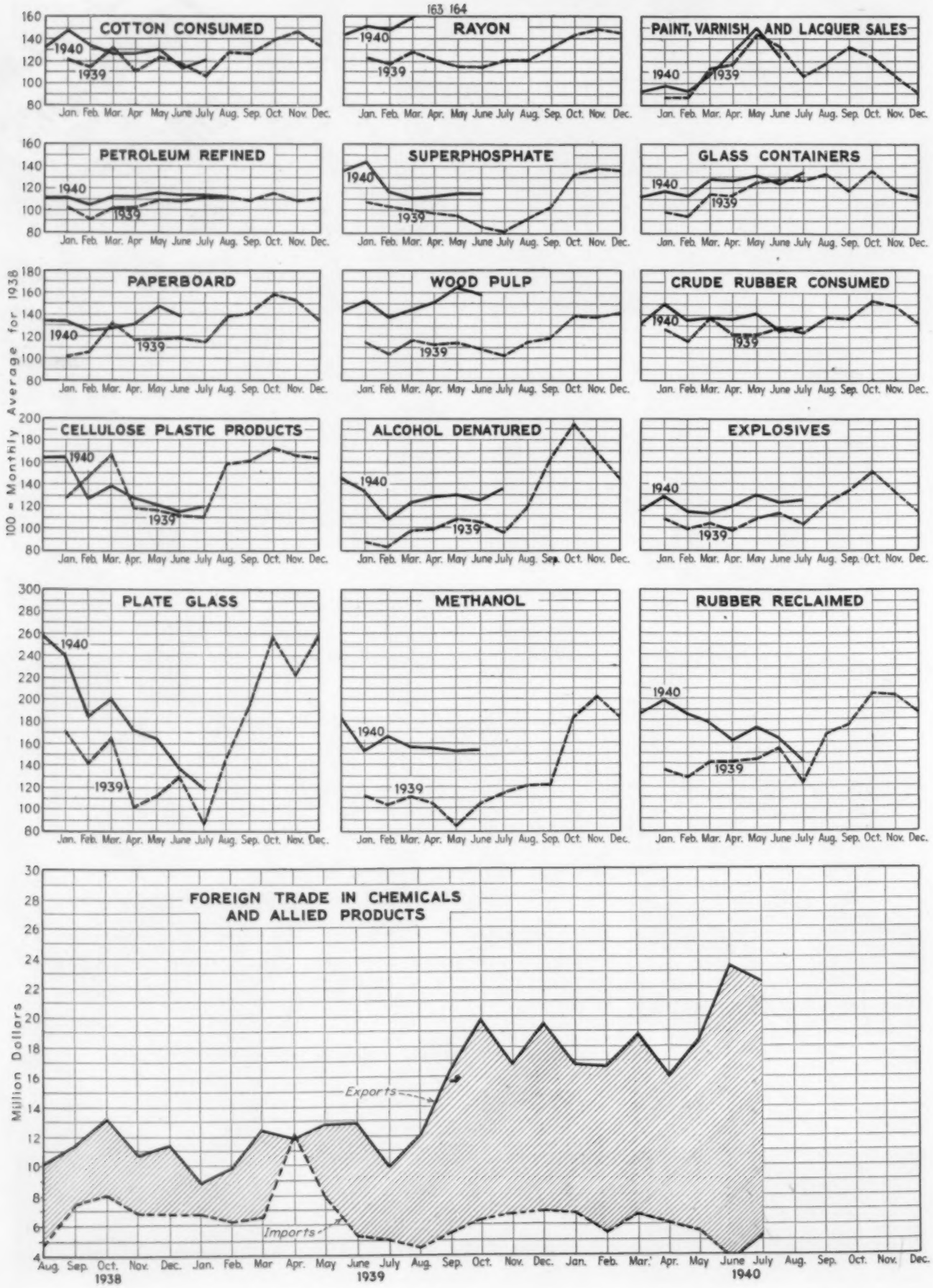
Chem & Met. 12-month Moving Average for Chemical Consumption
Chem & Met. Index for Chemical Consumption
Federal Reserve Board Index for all Production
Business Week Index of General Business Activity
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1938
1939
1940

**Production and Consumption Data for Chemical-Consuming Industries**

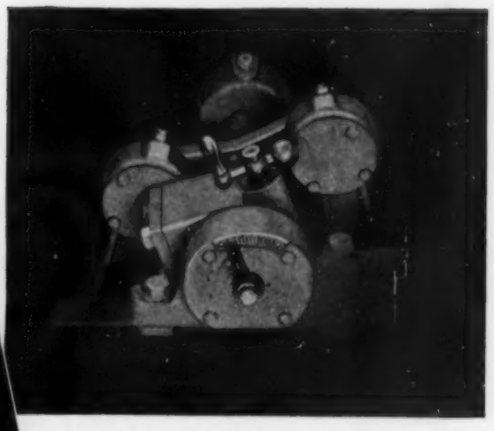
| | July 1940 | July 1939 | January-July 1940 | January-July 1939 | Per cent of gain for 1940 |
|---|---|---|---|---|---|
| **Production** | | | | | |
| Alcohol, ethyl, 1,000 pr. gal | 22,457 | 17,643 | 147,071 | 120,148 | 22.4 |
| Alcohol denatured, 1,000 wi. gal | 10,443 | 7,437 | 68,562 | 52,701 | 30.1 |
| Ammonia, liquor, 1,000 lb | 4,715 | 3,932 | 31,685 | 25,954 | 22.1 |
| Ammonium sulphate, tons | 60,718 | 46,666 | 401,425 | 296,572 | 35.4 |
| Automobiles, sales, no | 231,703 | 209,359 | 2,660,231 | 2,171,348 | 22.5 |
| Benzol, 1,000 gal | 11,727 | 8,219 | 73,813 | 51,786 | 42.5 |
| Byproduct coke, 1,000 tons | 4,612 | 3,354 | 30,063 | 21,571 | 39.4 |
| Glass containers, 1,000 gr | 4,780 | 4,393 | 31,486 | 28,938 | 8.8 |
| Plate glass, 1,000 sq. ft | 8,522 | 6,212 | 87,127 | 64,970 | 34.1 |
| Window glass, 1,000 boxes | 994 | 690 | 7,612 | 5,543 | 37.3 |
| Nitrocellulose plastics, 1,000 lb | 899 | 979 | 6,666 | 7,376 | 9.6* |
| Cellulose acetate plastics, 1,000 lb. | | | | | |
| Sheets, rods, and tubes | 565 | 561 | 4,504 | 4,968 | 9.3* |
| Molding material | 897 | 645 | 6,864 | 5,517 | 24.4 |
| Rubber reclaimed, tons | 14,342 | 11,777 | 122,866 | 93,960 | 30.8 |
| **Consumption** | | | | | |
| Cotton, bales | 597,850 | 521,353 | 4,433,872 | 4,059,718 | 9.2 |
| Silk, bales | 25,621 | 26,134 | 157,341 | 218,240 | 27.9* |
| Wool, 1,000 lb | 34,492 | 35,473 | 202,168 | 217,174 | 6.9* |
| Explosives, 1,000 lb | 33,340 | 27,652 | 228,810 | 197,168 | 16.1 |
| Rubber, crude, tons | 47,011 | 44,975 | 350,241 | 326,390 | 7.3 |
| Rubber, reclaimed, tons | 14,298 | 11,777 | 122,866 | 93,960 | 30.8 |

* Per cent of decrease.

# Production and Consumption Trends



# ANNOUNCING THE NEW DORRCO *V*-TYPE PUMP



*Above:* Stroke changing crank and dial

*Left:* Dorrco V-Type Pump—stroke regulator in circle

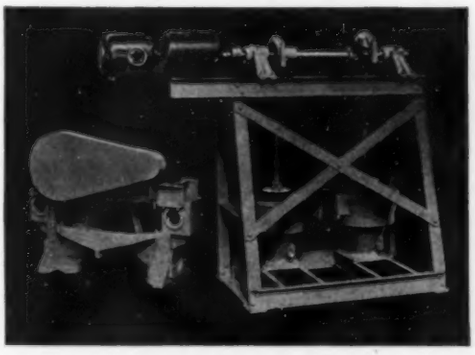
**STROKE ADJUSTMENT WHILE RUNNING**

A few turns on a conveniently located crank handle changes the strokes of the twin plungers on the fly, from a minimum of 5/8" to a maximum of 3", corresponding to a 5 to 1 variation in the rate of discharge.

The setting of the stroke is recorded by a pointer moving over the face of a dial calibrated in quarter-inch intervals.

## ADVANTAGES

- ★ *500% STROKE VARIATION WHILE RUNNING*
- ★ *46% LESS HEADROOM REQUIRED*
- ★ *2 TO 3 FT. VERTICAL LIFT OF DISCHARGE*
- ★ *SIMPLER AND QUICKER REPLACEMENT OF DIAPHRAGMS*
- ★ *GREASE LUBRICATED ANTI-FRICTION BEARINGS THROUGHOUT*
- ★ *BUILT-IN SPEED REDUCTION*



*A Study In Contrasts*—The old and the new, both 4 inch duplexs

*The* Dorrco V-Type Pump is an improved diaphragm suction pump, designed for handling sludges, pulps or slimes containing appreciable quantities of solid material. In it are combined all the best features incorporated in previous types of Dorrco Pumps, plus the new and desirable advantages cited above.

DORRCO

*This coupon will bring full details*

**The DORR COMPANY, Inc.**
**570 Lexington Avenue**
**New York, N. Y.**

Send me your bulletin No. 5001 on the Dorrco V-Type Pump.

*Name*_____

*Company*_____

*Address*_____

_____

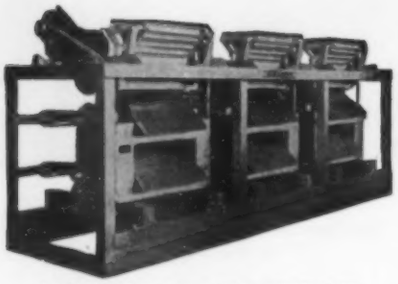
**The DORR COMPANY, Inc.**
**ENGINEERS, 570 Lexington Ave., New York**

ATLANTA · TORONTO · CHICAGO · DENVER · LOS ANGELES

DORR TECHNICAL SERVICES AND EQUIPMENT ARE ALSO AVAILABLE FROM THE FOLLOWING COMPANIES:
ENGLAND, Dorr Oliver Company Limited, London · NETHERLANDS: Dorr Oliver N. V., The Hague
FRANCE: Soc. Dorr Oliver, Paris · ITALY: S. A. I. Dorr Oliver, Milan · ARGENTINA: Luis Fiore, Buenos Aires
GERMANY: Dorr Gesellschaft, m. b. H. Berlin · SCANDINAVIA: A. B. Hedemora, Hedemora, Sweden
SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg · AUSTRALIA: Crossle & Duff Pty. Ltd., Melbourne
JAPAN: Sanki Engineering Company, Ltd., Tokyo · BRAZIL: Oscar Taves & Company, Rio de Janeiro

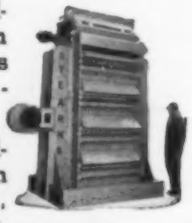
**FOR DIFFICULT MAGNETIC SEPARATION PROBLEMS SPECIFY**

*Stearns* **MAGNETIC**



STEARNS TYPE "K" HIGH INTENSITY MAGNETIC SEPARATOR

**Operating on the induction principle and capable of far more efficient performance at lower cost than the usual high intensity magnetic separator, the STEARNS Type "K" gravity induction separator provides positive magnetic separation of materials heretofore unresponsive, such as feldspar, gypsum rock, glass sand, abrasives, etc.**



STEARNS "KS"

**Stearns engineers design separators, conveyor magnets, drums, spouts and special magnets of all kinds.**

**Use our complete laboratory facilities for magnetic separation tests and possible application. Send us 25 to 50 lbs. of your typical material express prepaid for test, suggestions and recommendation.**

***Write for our interesting Bulletin 700***

**STEARNS MAGNETIC MANUFACTURING CO.**

**629 S. 28th St. Milwaukee, Wis.**


## CONTRACT DELIVERIES OF CHEMICALS RUNNING TO LARGER VOLUME IN CURRENT MONTH

SHIPPING instructions for September delivery are reported to indicate a larger movement to consumers in the current month. Most of the important consuming industries are said to have enlarged their requirements and in several cases less-than carlot buyers were more active in the market from the latter part of August, some influenced by fears that truck deliveries in the metropolitan area might be interrupted by labor troubles. As plans for the defense program become clarified, the immediate outlook for chemicals becomes more favorable as orders for government account are extending into numerous fields where chemicals are essential raw materials.

Price changes during the last month were infrequent and in general a firm tone underlies the market although producers are adhering to the policy of maintaining a steady market and some chemicals are offered at current levels for delivery over the remainder of the year. There are no indications of a trend toward higher or lower values and it is probable that only such selections as are sensitive to production costs will show price fluctuations in the near future. Prominent among price revisions in the last month was a reduction in the sales schedule for benzol. This material has been in plentiful supply in recent months and has been subjected to sales pressure and apparently is none too firm at the lowered level. In the solvents field, spirits of turpentine has been featured by a rising price trend and recent sales have been at figures higher than has prevailed for several months.

Prices for vegetable oils and animal fats have held at low levels for a long time with heavy stocks as the chief price factor. The statistical position remains unfavorable for any extended rise in values but there has been a recovery from the very low points reached around the middle of last month and if consumng markets show the expected improvement, this rising trend may continue within certain limits. Recent declines in prices quoted for linseed in the Argentine have been looked on with favor by crushers located along the Atlantic seaboard but western crushers still have an advantage both with respect to production cost of linseed oil and a better market for oil meal whereas eastern crushers are finding it difficult to replace foreign markets for the disposal of their oil cake and naturally in receiving a drawback on the duty paid on importations of Argentine seed.

An innovation in the oil trade was inaugurated on Sept. 3 when open trading in soybean oil futures was formally opened at the New York Produce Exchange. The contract is for 60,000 lb. of loose prime crude soybean oil produced from domestic beans and delivered in bonded warehouses, fob New York. Early trading found values very much in line with those quoted on a basis fob producing mills with freight charges representing the difference between producer and New York prices.

Recent advices from Brazil have revised downwards the estimate for castor bean production in that country for the present season. The new estimate places the probable outturn at 40,000 to 45,000 bu. Shipments of castor beans from Brazil to this country for the first half of this year were more than 10 per cent below the total shipped in the corresponding period of last year.

Of interest to the chemical industry is the report that when the new regional laboratory for the industrial utilization of farm products opens in Peoria, Ill., one of the first studies undertaken will be the industrial uses of corn, including the production of alcohol. At least 12 technicians will give their full time to the work on corn utilization. Special attention will be given to the probable use of corn products in the national defense program, including the production of synthetic rubber, plastics, substitute fibers and supplementary motor fuels. A complete pilot plant for the production of alcohol from corn is being installed in the laboratory so that a full study may be made of the technical difficulties involved in alcohol production, as well as its probable cost. Use of industrial corn alcohol as a motor fuel will be one of the principal studies.

A recently granted Norwegian patent and the announcement of an experimental plant to be built at Oslo have stirred the interest of chemical engineers in this country. It is reported that by use of dipicrylamine or hexanitrodiphenylamine the potassium salts in sea water may be precipitated. The precipitate may then be treated to recover the potash and the precipi-

### CHEM & MET.

**Weighted Index of**

### CHEMICAL PRICES

Base=100 for 1937

| | |
|---|---|
| **This month** | **98.68** |
| Last month | 98.63 |
| September, 1939 | 97.12 |
| September, 1938 | 99.55 |

Chemicals continued to move into consumption with very little price disturbance. The majority of heavy chemicals hold a steady price course with a few selections, notably metal salts fluctuate with the raw materials.

tating reagent. As far as is known, no activity on such a process has been planned in this country.

Exports of chemicals and related products were valued at $24,685,500 during July compared with $13,360,800 for July, 1939, an increase of 84 per cent, according to figures issued by the Department of Commerce.

Exports of explosives were valued at $4,629,350 during the month compared with $237,660 in July 1939, the gain being due largely to heavier demand for smokeless powder, shipments of which increased from $864 in July 1939 to $3,477,584 during the month under review.

Demand for coal-tar products continued heavy, particularly for dyes and related products, with the total value of shipments reaching $2,587,883 against $663,161 in July of last year. Exports of dyes, colors, stains and lakes during these periods increased in value from $345,089 in July 1939 to $1,589,245 during July of the current year.

Industrial chemical exports more than doubled in value, rising from $2,235,975 last July to $5,067,153 in July of the current year. Increases were general throughout the group, including sodium compounds, plastics, etc.

In the fertilizer field, there was noted a decline in tonnage of both phosphatic and potassic types from 154,800 to 122,837 tons, although the value of shipments increase dfrom $1,309,648 to $1,980,960, during these periods.

Certain items in the paint, varnish and lacquer group also declined somewhat, notably ready-mixed paints and lacquers, and bituminous paints, although the group, as a whole, increased in value from $1,716,498 to $1,888,960.

Imports of chemicals and related materials during July were valued at $14,772,700 compared with $11,590,000 during July, 1939, an increase of 28 per cent.

Items recording decreases during the period were medicinals and pharmaceuticals, industrial chemicals, paints and varnishes, fertilizers, industrial explosives, and soaps and toiletries. Flaxseed and cod-liver oil registered declines.

### CHEM & MET.

**Weighted Index of Prices for**

### OILS & FATS

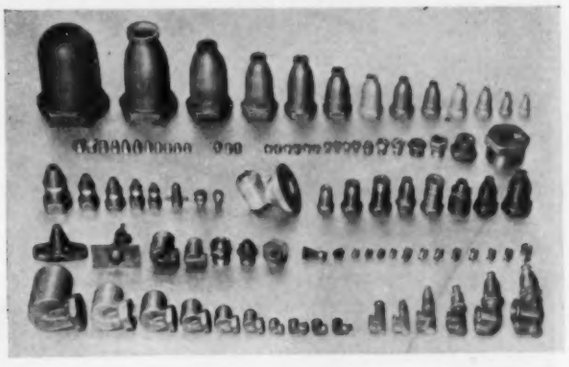
Base=100 for 1937

| | |
|---|---|
| This month | 67.43 |
| Last month | 68.24 |
| September, 1939 | 84.27 |
| September, 1938 | 73.54 |

Prices for oils and fats were sharply reduced in the early part of the period but partial recoveries have been made from the low points. The weighted index, however, shows a level lower than that reported a month ago.


# SPRACO NOZZLES

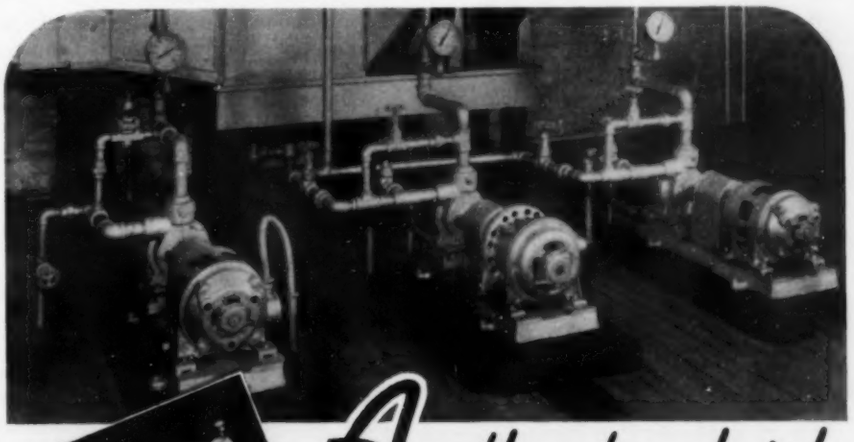
**for handling ACIDS and CAUSTIC SOLUTIONS**



**We make nozzles from practically any corrosion resisting material you can specify,—Durion, Hasteloy, Illium, Monel metal, nickel, Lava, plastics, stoneware, etc. If you have any nozzle problem involving corrosive fluids, we can help you.**

***For specific information write to***

**SPRAY ENGINEERING COMPANY**
**115 Central St.** **Somerville, Mass.**



*Another tough job*
**HANDLED with Westco PUMPS!**

Only Westco Pumps have renewable liners . . . insure low-cost stand-by protection.

These Westco Turbine-Type Pumps, in the Smith, Kline & French Laboratories, pump through ejectors at 75# pressure . . . to maintain a constant 28½" vacuum for research work. And there are 9 other Westcos installed in this modern Philadelphia plant! Investigate Westco . . . for your own requirements. Facts upon request.

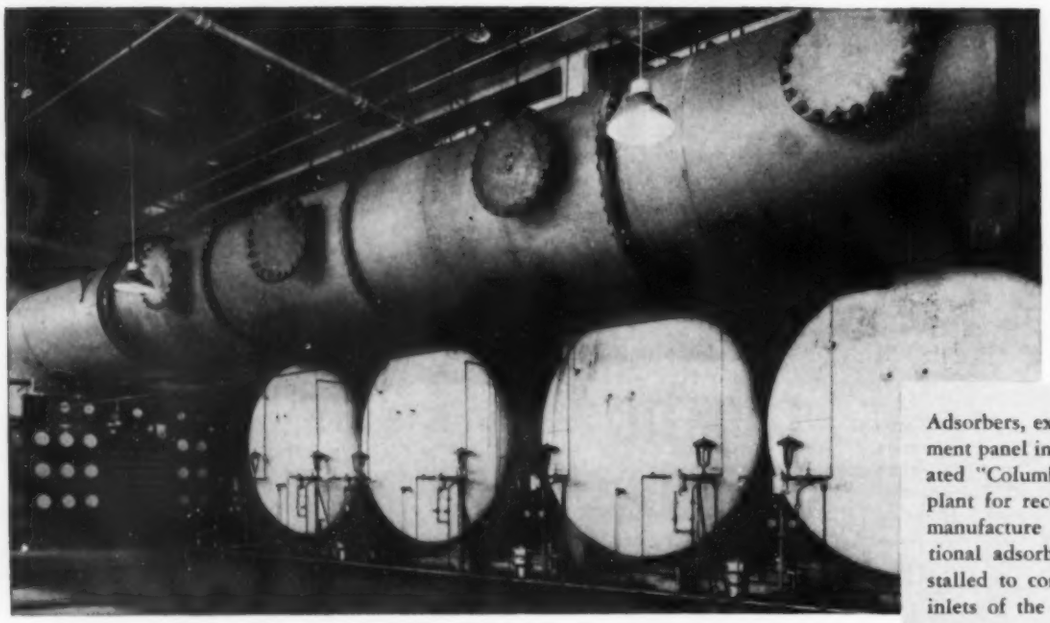
Gentlemen: We're anxious to cut costs. Tell us more about Westco Pumps.

**MICRO-WESTCO, Inc., 51009 State St., Bettendorf, Iowa**

Name..... Address.....

City..... State.....

**MICRO-WESTCO, INC.**



Adsorbers, exhaust duct, and instrument panel in an automatically operated "Columbia" Activated Carbon plant for recovering acetone in the manufacture of rayon. Four additional adsorbers are now being installed to connect with the capped inlets of the exhaust duct.

# How Waste of Volatile Solvents Can Be Prevented with "Columbia" Activated Carbon

NOW, more than ever, when conservation is the watchword, solvents vaporized in industrial operations should be recovered for re-use. This can be done efficiently and safely with a "Columbia" Activated Carbon solvent recovery plant, at a cost that is usually less than a cent a pound—a fraction of the cost of new solvent.

## What Solvents Can Be Recovered

Practically any one, or any combination of, the low-boiling solvents can be efficiently and economically recovered with "Columbia" Activated Carbon. These include: alcohols, chlorinated compounds, esters, ethers, hydrocarbons, and ketones.

## Where Solvents Can Be Recovered

Almost any quantity of solvent vaporized under conditions which permit the vapor-laden air to be collected from the industrial operation can be recovered with the "Columbia" Activated Carbon system, even though vapor concentration is extremely low and water vapor is present. Industries in which the system can be profitably used include: rayon, rubber, plastics, lacquer coating, linoleum, smokeless powder, rotogravure printing, dry cleaning, and solvent extraction of oils.

## Let Us Help You Save Your Solvent Dollars

If you vaporize solvents in your operations, we can help you determine whether you can recover them profitably with "Columbia" Activated Carbon. We can design and supply a complete recovery plant with guaranteed operating characteristics which permit quick amortization of the cost. Write us about your requirements and let us suggest what and where you can save.

## *Send for This Book!*

This book, which contains 32 pages and 26 illustrations, describes the "Columbia" Activated Carbon solvent recovery system, and tells how and where it can be used profitably. A request on your company letterhead will bring you a copy, without obligation.

The word "Columbia" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

*We supply complete solvent recovery plants with guaranteed operating characteristics.*

*For information concerning the uses of "Columbia" Activated Carbon, address:*

CARBIDE AND CARBON CHEMICALS CORPORATION

*Unit of Union Carbide and Carbon Corporation*

UCC

30 East 42nd Street, New York, N. Y.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

## INDUSTRIAL CHEMICALS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Acetone, drums, lb | $0.07½–$0.08 | $0.07½–$0.08 | $0.06½–$0.06½ |
| Acid, acetic, 28%, bbl., cwt | 2.23 – 2.48 | 2.23 – 2.48 | 2.23 – 2.48 |
| Glacial 99%, drums | 8.43 – 8.68 | 8.43 – 8.68 | 8.43 – 8.68 |
| U. S. P. reagent | 10.25 –10.50 | 10.25 –10.50 | 10.25 –10.50 |
| Boric, bbl., ton | 106.00–111.00 | 106.00–111.00 | 106.00–111.00 |
| Citric, kegs, lb | .20 – .23 | .20 – .23 | .20 – .23 |
| Formic, cbys., lb | .10½– .11 | .10½– .11 | .10½– .11 |
| Gallic, tech, bbl., lb | .90 – 1.00 | .90 – 1.00 | .70 – .75 |
| Hydrofluoric 30% drums, lb | .08 – .08½ | .08 – .08½ | .07 – .07½ |
| Lactic, 44%, tech., light, bbl., lb | .06½– .06¾ | .06½– .06¾ | .06½– .06¾ |
| Muriatic, 18°, tanks, cwt | 1.05 –..... | 1.05 –..... | 1.05 –..... |
| Nitric, 36°, carboys, lb | .05 – .05½ | .05 – .05½ | .05 – .05½ |
| Oleum, tanks, wks., ton | 18.50 –20.00 | 18.50 –..... | 18.50 –20.00 |
| Oxalic, crystals, bbl., lb | .10½– .12 | .10½– .12 | .10½– .12 |
| Phosphoric, tech., c'bys., lb | .07½– .08½ | .07½– .08½ | .07½– .08½ |
| Sulphuric, 60°, tanks, ton | 13.00 –..... | 13.00 –..... | 13.00 –..... |
| Sulphuric, 66°, tanks, ton | 16.50 –..... | 16.50 –..... | 16.50 –..... |
| Tannic, tech., bbl., lb | .54 – .56 | .54 – .56 | .40 – .45 |
| Tartaric, powd., bbl., lb | .41½–..... | .39½–..... | .29½–..... |
| Tungstic, bbl., lb | nom. ..... | nom. ..... | 2.35 –..... |
| Alcohol, amyl | –..... | –..... | –..... |
| From Pentane, tanks, lb | .101–..... | .101–..... | .101–..... |
| Alcohol, Butyl, tanks,llb | .09 –..... | .09 –..... | .07 –..... |
| Alcohol, Ethyl, 190 p'f., bbl., gal | 5.98 –..... | 5.98 –..... | 4.54 –..... |
| Denatured, 190 proof | –..... | –..... | –..... |
| No. 1 special, bbl., gal. wks. | .29½–..... | .29½–..... | .26½–..... |
| Alum, ammonia, lump, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Potash, lump, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Aluminum sulphate, com. bags, cwt | 1.15 – 1.40 | 1.15 – 1.40 | 1.15 – 1.40 |
| Iron free, bg., cwt | 1.60 – 1.70 | 1.60 – 1.70 | 1.30 – 1.55 |
| Aqua ammonia, 26°, drums, lb | .02½– .03 | .02½– .03 | .02 – .03 |
| tanks, lb | .02 – .02½ | .02 – .02½ | .02 – .02½ |
| Ammonia, anhydrous, cyl., lb | .16 –..... | .16 –..... | .15½– .16 |
| tanks, lb | .04½–..... | .04½–..... | .04½–..... |
| Ammonium carbonate, powd. tech., casks, lb | .09 – .12 | .09 – .12 | .08 – .12 |
| Sulphate, wks., cwt | 1.40 –..... | 1.40 –..... | 1.40 –..... |
| Amylacetate tech., from pentane, tanks, lb | .11½–..... | .11½–..... | .10½– .10½ |
| Antimony Oxide, bbl., lb | .13 –..... | .13 –..... | .11 –..... |
| Arsenic, white, powd., bbl., lb | .03½– .03¾ | .03 – .03¼ | .03 – .03¼ |
| Red, powd., kegs, lb | .17 – .18 | .17 – .18 | .15½– .16 |
| Barium carbonate, bbl., ton | 52.50 –57.50 | 52.50 –57.50 | 52.50 –57.50 |
| Chloride, bbl., ton | 79.00 –81.00 | 79.00 –81.00 | 79.00 –81.00 |
| Nitrate, casks, lb | .08½– .10 | .08½– .10 | .07 – .08 |
| Blanc fixe, dry, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Bleaching powder, f. o. b., wks., drums, cwt | 2.00 – 2.10 | 2.00 – 2.10 | 2.00 – 2.10 |
| Borax, gran., bags, ton | 43.00 –..... | 43.00 –..... | 48.00 –51.00 |
| Bromine, cs., lb | .30 – .32 | .30 – .32 | .30 – .32 |
| Calcium acetate, bags | 1.90 –..... | 1.90 –..... | 1.65 –..... |
| Arsenate, dr., lb | .06½– .06¾ | .06½– .06¾ | .06½– .07 |
| Carbide drums, lb | .04½– .05 | .04½– .05 | .05 – .06 |
| Chloride, fused, dr., del., ton | 19.00 –24.50 | 19.00 –24.50 | 21.50 –24.50 |
| flake, dr., del., ton | 20.50 –25.00 | 20.50 –25.00 | 23.00 –25.00 |
| Phosphate, bbl., lb | .07½– .08 | .07½– .08 | .07½– .08 |
| Carbon bisulphide, drums, lb | .05 – .06 | .05 – .06 | .05 – .06 |
| Tetrachloride drums, lb | .04½– .05½ | .04½– .05½ | .04½– .05½ |
| Chlorine, liquid, tanks, wks., lb | 1.75 –..... | 1.75 –..... | 1.75 –..... |
| Cylinders | .05½– .06 | .05½– .06 | .05½– .06 |
| Cobalt oxide, cans, lb | 1.84 – 1.87 | 1.84 – 1.87 | 1.67 – 1.70 |
| Copperas, bgs., f. o. b., wks., ton | 18.00 –19.00 | 18.00 –19.00 | 15.00 –16.00 |
| Copper carbonate, bbl., lb | .10 – .16½ | .10 – .16½ | .10 – .16 |
| Sulphate, bbl., cwt | 4.60 – 4.85 | 4.45 – 4.70 | 4.60 – 4.85 |
| Cream of tartar, bbl., lb | .34½–..... | .34½–..... | .24½–..... |
| Diethylene glycol, dr., lb | .22 – .23 | .22 – .23 | .22 – .23 |
| Epsom salt, dom., tech., bbl., cwt | 1.80 – 2.00 | 1.80 – 2.00 | 1.80 – 2.00 |
| Ethyl acetate, drums, lb | .07 –..... | .07 –..... | .061–..... |
| Formaldehyde, 40%, bbl., lb | .05½– .06 | .05½– .06½ | .05½– .06½ |
| Furfural, tanks, lb | .09 –..... | .09 –..... | .09 –..... |
| Fusel oil, ref. drums, lb | .16 – .17 | .16 – .17 | .12½– .14 |
| Glaubers salt, bags, cwt | .95 – 1.00 | .95 – 1.00 | .95 – 1.00 |
| Glycerine, c.p., drums, extra, lb | .12½–..... | .12½–..... | .12½–..... |
| Lead: | | | |
| White, basic carbonate, dry casks, lb | .07 –..... | .07 –..... | .07 –..... |
| White, basic sulphate, sck., lb | .06½–..... | .06½–..... | .06½–..... |
| Red, dry, sck., lb | .07½–..... | .07½–..... | .08 –..... |
| Lead acetate, white crys., bbl., lb | .11 – .12 | .11 – .12 | .10½– .11 |
| Lead arsenate, powd., bag, lb | .08½– .11 | .08½– .11 | .10 – .10½ |
| Lime, chem., bulk, ton | 8.50 –..... | 8.50–..... | 8.50 –..... |
| Litharge, pwd., csk., lb | .06½–..... | .06½–..... | .06½–..... |
| Lithophone, bags, lb | .036– .04 | .036– .04 | .04 – .04½ |
| Magnesium carb., tech., bags, lb | .06½– .06¾ | .06½– .06¾ | .06 – .06½ |

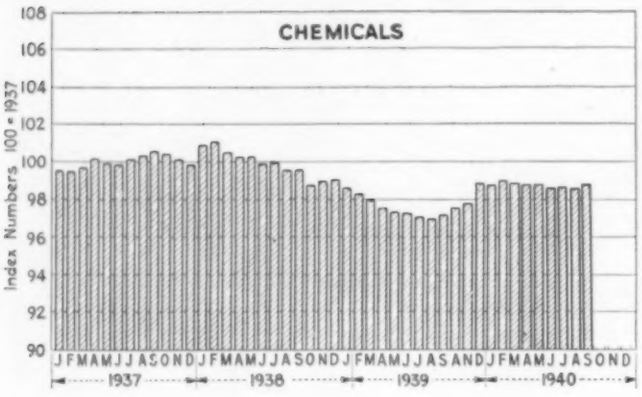
**The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Sept. 11**

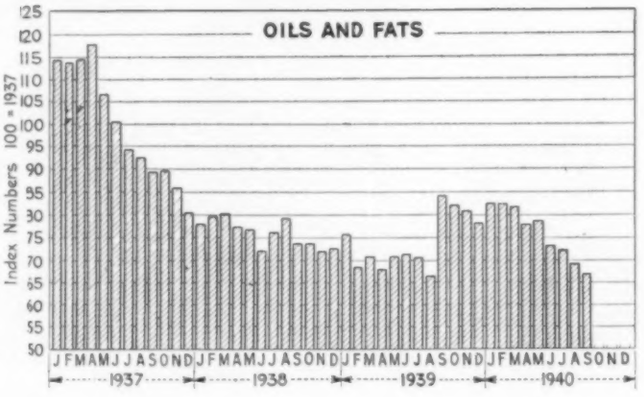
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Methanol, 95%, tanks, gal | .29 –..... | .29 –..... | .31 –..... |
| 97%, tanks, gal | .30 –..... | .30 –..... | .32 –..... |
| Synthetic, tanks, gal | .30 –..... | .30 –..... | .33 –..... |
| Nickel salt, double, bbl., lb | .13 – .13½ | .13 – .13½ | .13 – .13½ |
| Orange mineral, cak., lb | .10½–..... | .10½–..... | .10½–..... |
| Phosphorus, red, cases, lb | .40 – .42 | .40 – .42 | .40 – .42 |
| Yellow, cases, lb | .18 – .25 | .18 – .25 | .18 – .25 |
| Potassium bichromate, casks, lb | .08¼– .09 | .08¼– .09 | .08¼– .09 |
| Carbonate, 80–85%, calc. csk., lb | .06½– .07 | .06½– .07 | .06½– .07 |
| Chlorate, powd., lb | .10 – .12 | .10 – .12 | .09½–..... |
| Hydroxide(c'stic potash) dr., lb | .07 – .07½ | .07 – .07½ | .07 – .07½ |
| Muriate, 80% bgs., unit | .53½–..... | .53½–..... | .53½–..... |
| Nitrate, bbl., lb | .05½– .06 | .05½– .06 | .05½– .06 |
| Permanganate, drums, lb | .18½– .19 | .18½– .19 | .18½– .19 |
| Prussiate, yellow, casks, lb | .15 – .16 | .15 – .16 | .14 – .15 |
| Sal ammoniac, white, casks, lb | .05 – .06 | .05 – .06 | .05 – .05½ |
| Salsoda, bbl., cwt | 1.00 – 1.05 | 1.00 – 1.05 | 1.00 – 1.05 |
| Salt cake, bulk, ton | 23.00 –..... | 23.00 –..... | 13.00 –15.00 |
| Soda ash, light, 58%, bags, contract, cwt | 1.05 –..... | 1.05 –..... | 1.05 –..... |
| Dense, bags, cwt | 1.10 –..... | 1.10 –..... | 1.10 –..... |
| Soda, caustic, 76%, solid, drums, cwt | 2.30 – 3.00 | 2.30 – 3.00 | 2.30 – 3.00 |
| Acetate, works, bbl., lb | .04 – .05 | .04 – .05 | .04 – .05 |
| Bicarbonate, bbl., cwt | 1.70 – 2.00 | 1.70 – 2.00 | 1.70 – 2.00 |
| Bichromate, casks, lb | .06½– .07 | .06½– .07 | .06½– .07 |
| Bisulphate, bulk, ton | 16.00 –17.00 | 16.00 –17.00 | 15.00 –16.00 |
| Bisulphite, bbl., lb | .03 – .04 | .03 – .04 | .03½– .04 |
| Chlorate, kegs, lb | .06½– .06¾ | .06½– .06¾ | .06½– .06¾ |
| Cyanide, cases, dom., lb | .14 – .15 | .14 – .15 | .14 – .15 |
| Fluoride, bbl., lb | .07 – .08 | .07 – .08 | .07½– .08 |
| Hyposulphite, bbl., cwt | 2.40 – 2.50 | 2.40 – 2.50 | 2.40 – 2.50 |
| Metasilicate, bbl., cwt | 2.35 – 2.40 | 2.35 – 2.40 | 2.20 – 3.20 |
| Nitrate, bulk, cwt | 1.45 –..... | 1.45 –..... | 1.45 –..... |
| Nitrite, casks, lb | .06½– .07 | .06½– .07 | .06½– .07 |
| Phosphate, tribasic, bags, lb | 2.25 –..... | 2.25 –..... | 2.10 –..... |
| Prussiate, yel. drums, lb | .10½– .11 | .10½– .11 | .09½– .10 |
| Silicate (40° dr.) wks., cwt | .80 – .85 | .80 – .85 | .80 – .85 |
| Sulphide, fused, 60–62%, dr., lb | .02½– .03½ | .02½– .03 | .02½– .03 |
| Sulphite, crys., bbl., lb | .02½– .02¾ | .02½– .02¾ | .02½– .02¾ |
| Sulphur, crude at mine, bulk, ton | 16.00 –..... | 16.00 –..... | 18.00 –..... |
| Chloride, dr., lb | .03 – .04 | .03 – .04 | .03 – .04 |
| Dioxide, cyl., lb | .07 – .08 | .07 – .08 | .07 – .07½ |
| Flour, bag, cwt | 1.60 – 3.00 | 1.60 – 3.00 | 1.60 – 3.00 |
| Tin Oxide, bbl., lb | .51 –..... | .51 –..... | .54 –..... |
| Crystals, bbl., lb | .39½–..... | .39½–..... | .50½–..... |
| Zinc, chloride, gran., bbl., lb | .05 – .06 | .05 – .06 | .05 – .06 |
| Carbonate, bbl, lb | .14 – .15 | .14 – .15 | .14 – .15 |
| Cyanide, dr., lb | .33 – .35 | .33 – .35 | .33 – .35 |
| Dust, bbl., lb | .08½–..... | .08½–..... | .06½–..... |
| Zinc oxide, lead free, bag., lb | .06½–..... | .06½–..... | .06½–..... |
| 5% lead sulphate, bags, lb | .06½–..... | .06½–..... | .06½–..... |
| Sulphate, bbl., cwt | 3.05 – 3.25 | 2.75 – 3.00 | 2.75 – 3.00 |

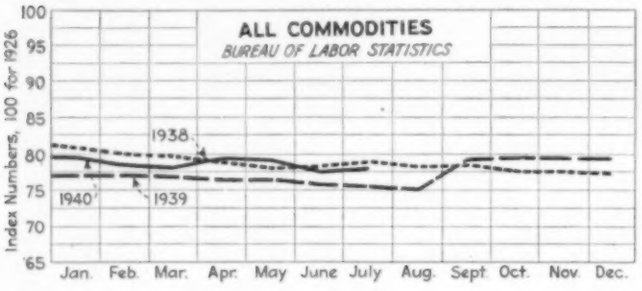
## OILS AND FATS

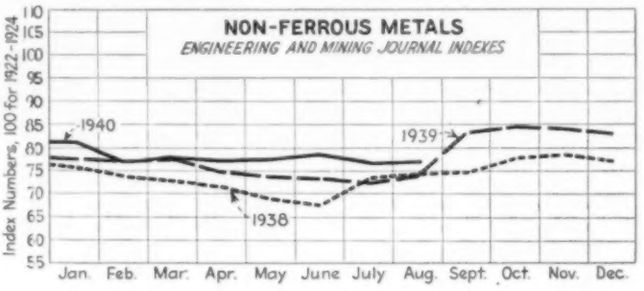
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Castor oil, 3 bbl., lb | $0.10½–$0.11 | $0.11½–$0.11 | $0.08½–$0.10 |
| Chinawood oil, bbl., lb | .26 –..... | .25 –..... | .27 –..... |
| Coconut oil, Ceylon, tank, N. Y., lb | .02½–..... | .02½–..... | .04½–..... |
| Corn oil crude, tanks (f. o. b. mill), lb | .05½–..... | .05 –..... | .07 –..... |
| Cottonseed oil, crude (f. o. b. mill), tanks, lb | .04½–..... | .04½–..... | .06½–..... |
| Linseed oil, raw car lots, bbl., lb | .084–..... | .088–..... | .095–..... |
| Palm, casks, lb | .03½–..... | .03½–..... | .04½–..... |
| Peanut oil, crude, tanks (mill), lb | .05½–..... | .05½–..... | .07 –..... |
| Rapeseed oil, refined, bbl., gal | 1.10 –..... | 1.10 –..... | .90 –..... |
| Soya bean, tank, lb | .04½–..... | .04½–..... | .06 –..... |
| Sulphur (olive foots), bbl., lb | .08½–..... | .08½–..... | .08 –..... |
| Cod, Newfoundland, bbl., gal | nom. ..... | nom. ..... | .32 –..... |
| Menhaden, light pressed, bbl., lb | .061–..... | .067–..... | .068–..... |
| Crude, tanks (f. o. b. factory), gal | .30 –..... | .35 –..... | .30 –..... |
| Grease, yellow, loose, lb | .03½–..... | .03½–..... | .05½–..... |
| Oleo stearine, lb | .05½–..... | .05½–..... | .09 –..... |
| Oleo oil, No. 1 | .06½–..... | .06½–..... | .07½–..... |
| Red oil, distilled, d.p. bbl., lb | .06½–..... | .06½–..... | .07½–..... |
| Tallow extra, loose, lb | .03½–..... | .03½–..... | .06 –..... |

# Chem. & Met.'s Weighted Price Indexes




## Coal-Tar Products

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Alpha-napthol, crude bbl., lb | $0.52 -$0.55 | $0.52 -$0.55 | $0.52 -$0.55 |
| Alpha-naphthylamine, bbl., lb | .32 - .34 | .32 - .34 | .32 - .34 |
| Aniline oil, drums, extra, lb | .15 - .16 | .15 - .16 | .15 - .16 |
| Aniline, salts, bbl., lb | .22 - .24 | .22 - .24 | .22 - .24 |
| Benzaldehyde, U.S.P., dr., lb | .85 - .95 | .85 - .95 | .85 - .95 |
| Benzidine base, bbl., lb | .70 - .75 | .70 - .75 | .70 - .75 |
| Benzoic acid, U.S.P., kgs., lb | .54 - .56 | .54 - .56 | .54 - .56 |
| Benzyl chloride, tech., dr., lb | .23 - .25 | .23 - .25 | .23 - .25 |
| Bensol, 90%, tanks, works, gal | .14 -..... | .15 - .18 | .16 - .18 |
| Beta-napthol, tech., drums, lb | .23 - .24 | .23 - .24 | .23 - .24 |
| Cresol, U.S.P., dr., lb | .09½- .10 | .09½- .10 | .10 - .11 |
| Cresylic acid, dr., wks., gal | .58 - .60 | .58 - .60 | .69 - .71 |
| Diethylaniline, dr., lb | .40 - .45 | .40 - .45 | .40 - .45 |
| Dinitrophenol, bbl., lb | .23 - .25 | .23 - .25 | .23 - .25 |
| Dinitrotoluol, bbl., lb | .15½- .16 | .15½- .16 | .15 - .16 |
| Dip oil, 15%, dr., gal | .23 - .25 | .23 - .25 | .23 - .25 |
| Diphenylamine, bbl., lb | .25 - .27 | .25 - .27 | .32 - .36 |
| H-acid, bbl., lb | .45 - .50 | .45 - .55 | .50 - .55 |
| Naphthalene, flake, bbl., lb | .07 - .07½ | .07 - .07½ | .05½- .06 |
| Nitrobenzene, dr., lb | .08 - .09 | .08 - .09 | .08 - .09 |
| Para-nitraniline, bbl., lb | .47 - .49 | .47 - .49 | .47 - .49 |
| Phenol, U.S.P., drums lb | .13 -..... | .13 -..... | .14½-..... |
| Picric acid, bbl., lb | .35 - .40 | .35 - .40 | .35 - .40 |
| Pyridine, dr., gal | 1.70 - 1.80 | 1.70 - 1.80 | 1.55 - 1.60 |
| Resorcinol, tech., kegs, lb | .75 - .80 | .75 - .80 | .75 - .80 |
| Salicylic acid, tech., bbl., lb | .33 - .40 | .33 - .40 | .33 - .40 |
| Solvent naptha, w.w., tanks, gal | .27 -..... | .27 -..... | .26 -..... |
| Tolidine, bbl., lb | .86 - .88 | .86 - .88 | .86 - .88 |
| Toluol, drums, works, gal | .30 -..... | .30 -..... | .27 -..... |
| Xylol, com, tanks, gal | .26 -..... | .27 -..... | .26 -..... |

## Miscellaneous

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Barytes, grd., white, bbl., ton | $22.00–$25.00 | $22.00–$25.00 | $22.00–$25.00 |
| Casein, tech., bbl., lb | .11½- .13 | .11½- .13 | .14 - .15½ |
| China clay, dom., f.o.b. mine, ton | 8.00 -20.00 | 8.00 -20.00 | 8.00 -20.00 |
| Dry colors | | | |
| Carbon gas, black (wks.), lb | .028- .30 | .028- .30 | .02½- .30 |
| Prussian blue, bbl., lb | .36 - .37 | .36 - .37 | .36 - .37 |
| Ultramarine blue, bbl., lb | .11 - .26 | .11 - .26 | .10 - .26 |
| Chrome green, bbl., lb | .21½- .30 | .21½- .30 | .21 - .27 |
| Carmine red, tins, lb | 4.85 - 5.00 | 4.85 - 5.00 | 4.35 - 4.40 |
| Para toner, lb | .75 - .80 | .75 - .80 | .75 - .80 |
| Vermilion, English, bbl., lb | nom..... | nom..... | 2.40 - 2.50 |
| Chrome yellow, C.P., bbl., lb | .14½- .15½ | .14½- .15½ | .14½- .15½ |
| Feldspar, No. 1 (f.o.b. N.C.), ton | 6.50 - 7.50 | 6.50 - 7.50 | 6.50 - 7.50 |
| Graphite, Ceylon, lump, bbl., lb | .06 - .06½ | .06 - .06½ | .06 - .06½ |
| Gum copal Congo, bags, lb | .08 - .30 | .08 - .30 | .06 - .30 |
| Manila, bags, lb | .09 - .15 | .09 - .14 | .09 - .14 |
| Damar, Batavia, cases, lb | .10 - .22 | .10 - .20 | .08 - .24 |
| Kauri, cases, lb | .18 - .60 | .18 - .60 | .18½- .60 |
| Kieselguhr (f.o.b. N.Y.), ton | 50.00 -55.00 | 50.00 -55.00 | 50.00 -55.00 |
| Magnesite, calc, ton | 50.00 -..... | 50.00 -..... | 50.00 -..... |
| Pumice stone, lump, bbl., lb | .05 - .07 | .05 - .08 | .05 - .07 |
| Imported, casks, lb | .03 - .04 | .03 - .04 | .03 - .04 |
| Rosin, H., 100 lb | 2.24 -..... | .222 -..... | ..... -..... |
| Turpentine, gal | .37½-..... | .33½-..... | .31½-..... |
| Shellac, orange, fine, bags, lb | .26 -..... | .26 -..... | .22 -..... |
| Bleached, bonedry, bags, lb | .25 -..... | .25 -..... | .21 -..... |
| T. N. Bags, lb | .14 -..... | .14 -..... | .14 -..... |
| Soapstone (f.o.b. Vt.), bags, ton | 10.00 -12.00 | 10.00 -12.00 | 10.00 -12.00 |
| Talc, 200 mesh (f.o.b. Vt.), ton | 8.00 - 8.50 | 8.00 - 8.50 | 8.00 - 8.50 |
| 300 mesh (f.o.b. Ga.), ton | 7.50 -10.00 | 7.50 -10.00 | 7.50 -11.00 |
| 225 mesh (f.o.b. N.Y.), ton | 13.75 -..... | 13.75 -..... | 13.75 -..... |

## Industrial Notes

GREENE, TWEED & CO., New York, is now represented in western Pennsylvania territory by John N. Harper with headquarters at Pittsburgh, and in northeastern Ohio by Joseph H. Maloney with headquarters in Cleveland.

THE MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J., has installed a mammoth new vulcanizer for vulcanizing rubber-lined tanks and other equipment for resisting corrosive liquids.

BETHLEHEM STEEL CORP., Bethlehem, Pa., has awarded a contract to the Wilputte Coke Oven Corp., for a battery of coke ovens for its plant at Lackawanna, N. Y.

MILTON ROY PUMPS, Philadelphia, has moved to 1300 East Mermaid Ave., Chestnut Hill.

HOKE INCORPORATE, New York, has moved its plant and offices to 585 Eagle Ave.

THE HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio, is building a new plant and its present plant will be entirely rearranged.

JOHN A. ROEBLING'S SONS CO., Trenton, N. J., has opened an export office at 19 Rector St., New York with William P. Laseter as manager. R. A. Hill has been appointed manager of a new office and warehouse in Houston, Texas.

THE SHERWIN-WILLIAMS CO., Cleveland, is expanding its plant at Chicago in order to increase its production of chemicals.

BAKELITE CORP., New York, a unit of Union Carbide and Carbon Corp., is building a plant at Bound Brook, N. J., for the manufacture of Bakelite urea molding materials. A pilot plant in Bound Brook has been making these materials since 1937.

GENERAL CONTROLS CO., Glendale, Calif., has moved its office in Kansas City to larger quarters at 421 Southwest Boulevard. E. V. Bialik is in charge of the office.

ALLIS-CHALMERS MFG. CO., Milwaukee, has appointed F. J. Geiger assistant manager of the electral department in which capacity he will be in charge of sales and engineering at the Norwood, Ohio, plant.

J. T. BAKER CHEMICAL CO., Phillipsburg, N. J., has brought Charles H. Slater from New York to the main office to manage sales of fine chemicals. Harold W. Feuchter succeeds as manager of the New York office.

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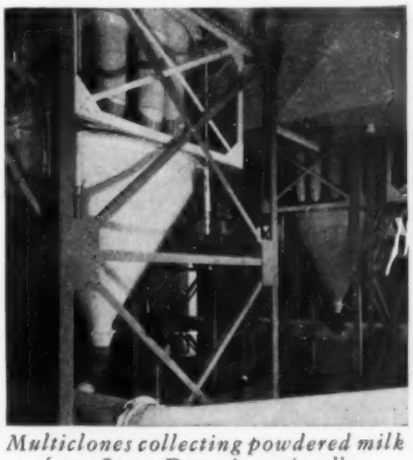

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# Chem & Met New CONSTRUCTION

| | Current Projects | | Cumulative 1940 | |
|---|---|---|---|---|
| | Proposed Work | Contracts | Proposed Work | Contracts |
| New England | ..... | $540,000 | $280,000 | $1,388,000 |
| Middle Atlantic | $815,000 | 2,948,000 | 9,665,000 | 8,912,000 |
| South | ..... | 26,250,000 | 12,455,000 | 33,915,000 |
| Middle West | 790,000 | 14,255,000 | 7,980,000 | 4,175,000 |
| West of Mississippi | 1,200,000 | 3,100,000 | 25,515,000 | 17,122,000 |
| Far West | ..... | ..... | 4,990,000 | 3,238,000 |
| Canada | 2,280,000 | 20,100,000 | 27,885,000 | 22,260,000 |
| Total | $5,145,000 | $67,193,000 | $88,770,000 | $91,010,000 |

## PROPOSED WORK

**Chemical Plant**—Monsanto Chemical Co., 2314 Union Guardian Bldg., Detroit, Mich., has acquired a 138 acre site on the Detroit River at Trenton, Mich., and plans to construct a factory for the manufacture of phosphoric acid and phosphates.

**Chemurgic Plants**—Texas Chemurgic Industries, Inc., c/o William C. Witt, Pres., Dallas, Tex., and Gilbert C. Wilson, Research Chemist, c/o North Texas State Teachers College, Denton, Tex., plans to construct seven or eight chemurgic plants at various locations throughout Texas. First unit will be established at Longview to cost $60,000.

**Chemical Storage Building**—Charles Pfizer Co., 11 Bartlett St., Brooklyn, N. Y., plans to construct a 4 story chemical storage building at 632-50 Flushing Ave., Brooklyn. A. V. Bekay, 323 Elmwood Ave., Brooklyn, Engr. Estimated cost $275,000.

**Coke Ovens**—Bethlehem Steel Co., Bethlehem, Pa., plans to construct 76 new ovens at its plant at Lackawanna, N. Y. Estimated cost will exceed $500,000.

**Glass Factory**—Industrial Glass Co., c/o A. Nihow, Archt., 133 St. Paul St., W., Montreal, Que., plans to construct a factory at St. Laurent, Que. Estimated cost $50,000.

**Oil Refinery**—Independent refining Co., Arp, Tex., plans to install a polymerization unit in its refinery. Estimated cost $100,000.

**Oil Refinery**—McBride Refining Co. c/o L. McBride, Edcouch, Tex., plans general improvements and expansion of refinery, also new steel storage tanks. Estimated cost $100,000.

**Oil Refinery**—Magnolia Petroleum Co., Fort Worth, Tex., plans to enlarge its refinery. Estimated cost $150,000.

**Oil Refinery**—Shell Oil Co., Shell Bldg. Houston, Tex., plans to construct a plant for the manufacture of Butadiene near Harrisburg, Tex., to cost $300,000; also one to manufacture Toluene, a TNT ingredient to cost $450,000.

**Paint Factory**—Industrial Coating Co., Ltd., 255 Logan Ave., Toronto, Ont., Can., plans to construct a factory on Eastern Ave. Estimated cost $40,000.

**Paint Factory**—Sherwin-Williams Paint Co., Gloucester, N. J., plans to construct an addition to its factory here.

**Paint Warehouse**—Sherwin-Williams Co., 115th St. and Cottage Grove Ave., Chicago, Ill., is having plans prepared by A. Kahn, Archt., New Center Bldg., Detroit, Mich., for a 1 story, 300x700 ft. warehouse. Estimated cost $750,000.

**Paper Mill**—Consolidated Paper Corp., Ltd., Sun Life Bldg., Montreal, Que., Can., is having plans prepared for modernizing and improving its mill at Three Rivers, Que. R. Collins c/o owners, Engr. Estimated cost $1,000,000.

**Processing Plant**—Gaspesian Products, 100 St. Paul St., E., Montreal, Que., Can., plans to construct a plant for the manufacture of fish oils, etc., and also for processing other sea products at Bonaventure, Que. Estimated cost $40,000.

**Pulp Mill**—St. Laurence Paper Co., Ltd., Sun Life Bldg., Montreal, Que., Can., plans to rehabilitate its pulp and paper mill at Three Rivers, Que. Estimated cost $150,000.

**Rubber Factory**—Dryden Rubber Co., Keokuk, Ia., plans to construct an addition to its factory. Estimated cost $100,000.

**Sulphuric Acid Plant**—Nichols Chemical Co., Ltd., 1111 Beaver Hall Hill, Montreal, Que., Can., will soon award the contract for a sulphuric acid plant. Estimated cost $1,000,000.

## CONTRACTS AWARDED

**Ammonium Nitrate Plant**—Department of National Defense, Ottawa, Ont., Can., has awarded the contract for an ammonium nitrate plant in Alberta to Consolidated Mining & Smelting Co., Ltd., Vancouver, B. C., Can. Estimated cost $8,000,000.

**Ammunition Loading Plant**—U. S. War Department, Washington, D. C., will construct ammunition loading plant near Ravenna, O. Work will be done under supervision of Atlas Powder Co., Wilmington, Del., who have let contract for construction to Hunkin-Conkey Construction Co., 1740 East 12th St., Cleveland, O. Estimated cost $14,215,000.

**Chemical Plant**—American Cyanamid Corp., West Main St., Stamford, Conn., has awarded the contract for a 1 and 3 story, 162x225 ft. chemical plant for production of resin for plastics at Wallingford, Conn., to Miller-Davis Co., Kalamazoo, Mich. Estimated cost $500,000.

**Chemical Plant**—North American Cyanamid, Ltd., Fourth St., Niagara Falls, Ont., Can., has awarded the contract for a plant in Stamford Twp., near Port Robinson, Ont., to Chemical Construction Co., subsidiary of American Cyanamid Co., 30 Rockefeller Plaza, N. Y. Estimated cost $12,000,000.

**Clay Pipe Plant**—Robinson Clay Products Co., National Bldg., Akron, Ohio, has awarded the contract for a plant at Pottstown, Pa., to Jacob R. Fox, Jr., D and Luzerne Sts., Philadelphia, Pa. Estimated cost $750,000.

**Clay Products Plant**—Mid-Co. Products Co., c/o A. Hantla, Plant Mgr., Lufkin, Tex., will construct and equip a clay products manufacturing plant. Work will be done by day labor and subcontracts. Estimated cost $60,000.

**Drug Manufacturing Plant**—Sterling Products, Inc., 170 Varick St., New York, N. Y., has awarded the contract for a 4 story, 80x400 ft. factory at Rahway, N. J., to Samworth-Hughes Co., Inc., 177 Van Houten St., Paterson, N. J. Estimated cost $600,000.

**Factory**—Midland Rubber Co., 211 A Ave. N. E., Cedar Rapids, Ia., has awarded the contract for constructing a factory building, to McIntyre Construction Co., Cedar Rapids, Ia. Estimated cost $40,000.

**Oil Refinery**—Davis & Co., Inc., c/o N. V. Hansell, Pres., 1322-40 Commerce Bldg., Houston, Tex., and c/o F. W. Hofmoke, Port Dir., Brownsville, Tex., has awarded the contract for oil and gasoline refinery and by-products manufacturing plant at Brownsville, to Winkle-Koch Engineering Co., 335 West Lewis St., Wichita, Kan. Estimated cost $2,000,000.

**Oil Refinery**—Standard Oil Co. of New Jersey, 26 Bway., New York, N. Y., has awarded the contract for a refinery at Linden, N. J., to Spearin, Preston & Burrows, Inc., 50 Church St., New York, N. Y., at $478,000.

**Oil Refinery**—Standard Oil Co., Midland Bldg., Cleveland, O., Howard West, engr. in charge, has awarded the contract for constructing a catalytic cracking process oil refinery, to M. W. Kellogg Co., 225 Broadway, New York, N. Y.

**Paint Plant**—Wadsworth-Howland Co., Green St., Malden, Mass., has awarded the contract for constructing a 4 story and basement paint plant, to Hegeman-Harris, 161 Devonshire St., Boston, Mass. Estimated cost over $40,000.

**Powder Plant**—Hercules Powder Co., Delaware Trust Bldg., Wilmington, Del., will construct a nitro-cellulose addition to its plant at Parlin, N. J. Work will be done by owner. Estimated cost $1,000,000.

**Powder Plant**—U. S. War Department, Washington, D. C., has awarded the contract for a smokeless powder plant at Radford, Va., to Hercules Powder Co., Delaware Trust Sherbrook St. W., Montreal. Estimated cost $25,000,000.

**Recycling Plant**—Cotton Valley Recycling Co., Shreveport, La., has awarded the contract for a recycling plant to Hudson Engineering Co., M & M Bldg., Houston, Tex. Estimated cost $1,250,000.

**Recycling Plant**—Davis & Co., Inc., c/o N. V. Hansell, Pres., 1322-40 Commerce Bldg., Houston, Tex., and 30 Rockefeller Plaza, New York, N. Y., has awarded the contract for recycling, repressuring and absorption plant in Rincon Field, Starr Co., near Rio Grande City, Tex., to Hudson Engineering Co., M & M Bldg., Houston, about $600,000. Total estimate $1,000,000.

**Rubber Plant**—Dominion Rubber Co., Ltd., Papeneau Ave., Montreal, Que., has awarded the contract for a 57x59 ft. addition to its plant, to Anglin-Norcross Co., Ltd., 874 Sherbrook St. W., Montreal. Estimated cost $40,000.

**Talc Plant**—W. H. Loomis Talc Corp., Gouverneur, N. Y., will build a 1 story, 126x136 ft. plant. S. B. Howe, engr. in charge of construction. Estimated cost $40,000.

**Varnish Plant**—Schenectady Varnish Co., Inc., 1302 Congress St., Schenectady, N. Y., has awarded the contract for a 2 story, 40x122 ft. plant building, to Hanrahan Bros., 952 Wendell St., Schenectady.

**Warehouse**—B. C. Sugar Refinery Co., Ltd., Rogers St., Vancouver, B. C., has awarded the contract for constructing a warehouse to Dominion Construction Co., Ltd., 509 Richards St., Vancouver, B. C. $60,000.

**Warehouse**—Corning Glass Works, Corning, N. Y., has awarded the contract for a 1-story, 60x260 ft. warehouse addition at Wellsboro, Pa., to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $40,000.